PB187290

A SYSTEMS STUDY
OF
SOLID WASTE MANAGEMENT
IN THE
FRESNO AREA

FINAL REPORT
ON A SOLID WASTE
MANAGEMENT DEMONSTRATION

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This report (SW-5d) was prepared for
the California Department of Health
by the Aerojet-General Corporation
in cooperation with Engineering-Science, Inc.,
supported in part by a demonstration grant (D01-UI-00021)
from the Bureau of Solid Waste Management

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FOREWORD

An estimated 900 million pounds of wastes in the solid state are produced in the United States every day. What to do with these solid wastes, how to dispose of them without needlessly endangering public health and welfare, and how to recover and reuse valuable materials now "thrown away" are among the most challenging and perplexing of current national problems. Because of lack of suitable planning, interest, and public understanding, these problems have reached such proportions that nationwide attention is demanded and action for the development of adequate solutions must be taken.

Intensified action concerning these problems was made possible by the Solid Waste Disposal Act, Title II of Public Law 89-272, which was signed by the President on October 20, 1965. This legislation directs the Secretary of the Department of Health, Education, and Welfare to initiate, encourage, and support a national program aimed at discovering and evaluating better methods of coping with the solid waste problem.

The Secretary is authorized (1) to conduct and support research on the nature and scope of the problem, on methods of more safely and efficiently collecting and disposing of solid wastes, and on techniques for recovering from solid wastes potentially valuable materials and energy; (2) to provide training and financial and technical assistance to local and State agencies and other organizations in the planning, development, and conduct of solid waste management programs; (3) to encourage and support projects that may demonstrate new and improved methods of solid waste collection, handling, and disposal. The Bureau of Solid Waste Management carries out these responsibilities.

Among these responsibilities, the Bureau provides grant support for demonstrations relating to the development and application of new and improved methods of solid waste collection, storage, processing, and ultimate disposal; and grants for studies and investigations that may lead to a demonstration of improved disposal practices, or may provide solutions for regional or national solid waste disposal problems. Associated with this is the responsibility for collecting and making available by appropriate means the results of, and other information pertaining to, such federally supported demonstrations, studies and investigations.

Accordingly, this report has been reproduced to disseminate as widely as possible the latest available information and findings of a project that has received grant support from the Bureau of Solid Waste Management. It is hoped that it will provide those working in this field with useful information that will be of assistance in developing approaches to the solutions of their solid waste disposal problems.

RICHARD D. VAUGHAN, *Director*
Bureau of Solid Waste Management

PREFACE

This report was prepared for the California Department of Public Health by the Aerojet-General Corporation in cooperation with Engineering-Science, Inc., and describes a systems study of solid waste management in the Fresno, California, area. The study was supported in part by demonstration grant No. D01-UI-00021, Bureau of Solid Waste Management, under provisions of the Solid Waste Disposal Act (PL 89-272).

Objectives of the study were: (1) to determine an optimum solution to the Fresno solid waste problem; (2) to develop technology for the Fresno region that might be applied to other areas. To meet these objectives, a method was developed for measuring the effectiveness of any solid waste system. This method of measurement was then used to assess present Fresno conditions and to evaluate alternative systems. The measurement method was based on the rating of 82 different solid wastes according to 13 "environmental bad effects." A systems technique is used that covers the categories quite thoroughly; although the specific ratings are valid only for the Fresno region, the procedure may be used to develop ratings for any area.

The report recommends a regional solid waste management system to be attained by the year 2000, which will consist of composting a mixture of municipal wastes and manure, composting other agricultural wastes, and landfilling nearly all noncompostable wastes. Little incineration is proposed. Storage of refuse is to be in underground conduits accessible to each home. Collection is proposed by special vehicles that will remove bagged refuse from the conduits by vacuum. Salvage can be included in the system if technology makes it feasible.

--ANTON J. MUHICH, *Director*
Division of Demonstration Operations

STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY RONALD REAGAN, Governor

DEPARTMENT OF PUBLIC HEALTH
2151 BERKELEY WAY
BERKELEY 94704

July 18, 1968

The Fresno County Board of Supervisors
And
The City Councils of Municipalities Concerned

Gentlemen:

Numerous discussions between official agencies under your jurisdiction and representatives of this Department during the early part of 1966 evidenced a common understanding of the acute need for a comprehensive analysis of the growing problem of solid wastes in the greater Fresno area. Based on this understanding, the State Department of Public Health made application for and was awarded a grant from the U.S. Public Health Service to undertake a systems-oriented study of the community, industrial, and agricultural solid wastes management needs of Central Fresno County. The Fresno area was agreed upon as the focal point for this project inasmuch as it typifies the growing urban-rural problems facing many areas in California and the nation.

This undertaking represented the first systematic effort to analyze both quantitatively and qualitatively all of the solid waste problems of a major region and of developing a rationally based system for dealing with these problems. The results of this study clearly demonstrate the need to direct such programs toward the coordinated goals of environmental health: clean air, pure water, and unblighted land favorable to the needs of agriculture, residence, industry and recreation, acknowledging the practical considerations of economics and function and responsibilities of local government.

This two-year study, now completed, was a joint undertaking of government and private enterprise. Systems analysis and engineering phases were contracted to Aerojet-General Corporation, which collaborated with Engineering-Science, Inc. This Department and the Fresno County Health Department were responsible cooperatively for public information development and coordination of the project. Local planning, public works, educational and agricultural specialists participated actively and contributed importantly. Representatives of the private sector, especially agri-business, industry and various public service organizations maintained a vital interest in and actively supported the study.

Although the first phase --- that of determining the solid waste management needs of Central Fresno County --- is now accomplished, the major challenges set forth within the recommendations of the accompanying report remain to be confronted. Implementation of the system suited to your region will require the development of a unified administrative structure to carry out the program. This will call for representation from the several political entities sharing interest in and responsibility for various aspects of solid waste management, adequate financing, and the further development of the kind of public support that will ultimately determine the success of the program to be undertaken.

The solutions and decisions regarding these challenges must be developed largely by the people through their local officials within Fresno County. The accompanying report provides an analysis of alternatives and offers guidelines to assist in making these decisions. We believe that the approaches to solid waste management outlined in this report represent sound and realistic means of averting an impending solid waste crisis in the Fresno region. The information contained in this report also has considerable application to other similar regions throughout the United States.

It must be recognized that significant improvements in solid waste management systems inevitably require a substantial investment, although one which will pay long-range dividends sufficient to justify the investment. If the safeguarding and improvement of the environment and enhancement of urban-rural coexistence are the dividends, the investment is sound. It is vital, however, in providing a true economic projection to consider the indirect costs of a continuously degrading environment, brought on by the presently uncontrolled forces within a rapidly growing and changing area. The challenge before us is to provide maximum protection for our people and our environmental resources at a cost that we can afford to pay. We believe that the program plan outlined in the attached report meets these criteria.

It is with pleasure that we submit the report on "The California Integrated Solid Waste Management Project - A Systems Study of Solid Waste Management in the Fresno Area". The problem has been defined and suggested solid waste management methods have been developed. The policy decisions must now be made locally, leading to needed implementation. This Department, which is vitally interested in the solid waste management needs of Fresno County, as well as elsewhere in California, stands ready to assist in every way possible in the implementation of this program.

Very sincerely yours,

Richard F. Peters

Richard F. Peters, Chief
BUREAU OF VECTOR CONTROL

RFP/tv

THE CALIFORNIA INTEGRATED SOLID WASTES MANAGEMENT PROJECT ITS SIGNIFICANCE AS VIEWED BY THE CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

Studies in California over more than two decades have shown that there is a serious and persistent lag in the development and application of adequate solid wastes management techniques. Although a few communities have produced excellent detailed plans and operated model systems, rapid urbanization or other unforeseen developments soon created newer and more difficult problems to solve. In order to keep costs low, local governments generally have felt no pressures to investigate or encourage the development of new and efficient techniques for waste management. This in turn has tended to discourage private enterprise from developing more efficient ways of handling solid waste materials.

In the past three years, however, important developments have focused special attention on the quality of California's natural environment. Political leaders, in the State as well as nationally, have become personally involved in the drive to protect the quality of our natural resources particularly those of land, water, and air. Federal legislation has provided the necessary funds to start serious programs for improving solid waste management.

The California Department of Public Health critically reviewed the impact of solid waste problems in California in 1965 and determined that there was urgent need to revamp the fragmented and uncoordinated approaches to solid waste management that were then in effect. As a result of these developments, the State Department of Public Health assisted by grants from the Public Health Service initiated two major solid waste projects in July 1966. One of these, "The California Solid Waste Planning Study", is a departmental effort concerned with an analysis of solid wastes throughout California and is designed to inventory present management practices and to develop a comprehensive program plan for future management of these wastes within the State.

The other project, "The California Integrated Solid Wastes Management Project" is an intensive and coordinated effort between the State, local agencies in Fresno County, and private industry to investigate, plan, design and implement a regional wastes management system that will handle all urban, industrial and agricultural wastes in a rapidly urbanizing 1200 square mile area surrounding the City of Fresno. This portion of Fresno County was selected for the study because it has typical urban-rural solid waste problems that are representative of many other locations in California and in other states. The selection was also influenced by the enthusiastic support of city and county officials.

In general, the basic objectives of the Fresno Project were to determine an optimum solution to the Fresno region solid waste management problems and to develop a technology for systematic study of the Fresno region that may be applied to solve solid waste management problems in other similar regions.

The project involved five interrelated tasks for implementing a total waste management system. These tasks covered: (1) a public education program, including the production of a motion picture film, (2) a rigorous systems analysis study of solid waste management in the intra-county region, (3) special entomological investigations, (4) development of solid waste management guidelines, and (5) development of a program of implementation. The systems analysis study, published in the following pages of this report, was performed through contract by the Aerojet-General Corporation in cooperation with Engineering-Science, Inc. This consortium was selected from a large number of qualified firms on the basis of detailed project proposals, technical capabilities, experience, and staff resources. Related project responsibilities such as general supervision, agency coordination, environmental criteria, vector control recommendations, public eduction, and project administration were performed by the State and Fresno County Health Departments.

The Fresno Study has shown conclusively that the "systems" concept provides a new perspective in analyzing the problems of solid waste management. It has developed a long-range conceptual management plan for a rapidly urbanizing area that will meet predetermined health, aesthetic, legal, socioeconomic, and projected management goals to provide an optimum environment for the urban, agricultural and industrial communities in the area. Of particular significance are the following results of the study:

1. Following a comprehensive review and engineering analysis, a conceptual system has been developed to economically, efficiently and satisfactorily handle the 5.5 million tons of municipal, industrial, and agricultural wastes expected to be produced annually in the study area.
2. The development and documentation of a method of measurement by which the effectiveness of any system of solid wastes management might be evaluated and compared with alternative systems in terms of the extent to which they solve the environmental, socioeconomic, and aesthetic problems engendered by solid wastes.
3. A detailed identification, classification, and evaluation, of solid wastes and the problems they create in the environment as well as the groups or agencies affected by these problems.

The California Department of Public Health has reviewed and accepted the ensuing report of the contractor. It is expected that this report will lead to early implementation in the Fresno region. It is recognized that other elements of solid waste management technology not detailed in this report may have potential and are currently being investigated and developed elsewhere. Such new techniques need to be carefully reviewed as they are developed and as implementation of the project progresses; they may then be incorporated into the long-range plans if warranted on a cost/benefit basis.

California is currently faced with numerous problems in developing long-range solutions to solid waste problems confronting the urban-rural areas of the state. This report and its implementation will hopefully provide the basis for planning and developing long-range solutions to similar situations. It is imperative that the urban-rural centers of the state awaken to the need for developing new solid waste management policies and programs in order to preserve our agricultural enterprise, our community growth, and the quality of our environment. This report has established the basic means by which this goal can be achieved.

FOREWORD

This report is submitted in fulfillment of the State of California Standard Agreement No. 15100. It covers work performed during the period from 15 September 1966 to 31 March 1968.

The study was performed under the cognizance of the California State Department of Public Health, Bureau of Vector Control; Richard F. Peters, Chief. Paul P. Maier, State Project Administrator, provided substantial advice and counsel and enabled the study to be conducted in close cooperation with area agencies as well as the statewide solid waste study being performed concurrently by the Bureau of Vector Control. Solid waste activities conducted by the Bureau are under the direction of Peter A. Rogers. It is particularly appropriate to recognize the unique contribution of Frank M. Stead, retired Chief of the Division of Environmental Sanitation, California Department of Public Health, who originated the concept and provided the initiative to develop the system study programs for the Fresno area. His advise and counsel have been of great assistance to those conducting this study.

The study has been directed by Frank R. Bowerman, Program Manager, of Aerojet-General Corporation, with the assistance of Robert E. Mitchell, Assistant Program Manager, in cooperation with Engineering-Science, Inc., headed by Dr. Harvey F. Ludwig, President, and the cooperation of various State and local agencies. Robert N. Richards, Rodney C. Hanson, and Leonard L. Rotter of Aerojet; and Donald R. Anderson, Houshang Esmaili, Ed Spira, Hans Wasmer, and Philip N. Storrs of Engineering-Science were significant contributors to the effort.

Harold Tokmakian, Fresno County Planning Director; Reinard E. Bergstrom, Fresno County Director of Environmental Health; Clinton Berry, Fresno County Director of Public Works; and James L. Martin, Fresno City Public Works Director, were particularly helpful throughout the study effort.

The performance scoring procedure developed in the study report is based on information obtained from experts in the environmental sciences field. Without the knowledge and willing assistance of these engineers and scientists (listed in Table III-3) the development of this scoring procedure would have been doubtful. Their cooperation is gratefully acknowledged.

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ABSTRACT

The basic objectives of the Fresno Region Solid Waste Management Study were to (a) determine an optimum system for the management of solid wastes in the Fresno Region and (b) to develop a technology for that determination that would be applicable to other similar regions throughout California and the Nation. To do so meant the development of a method for evaluating the integrated adverse environmental effects of solid wastes. This decision-making machinery encompasses all the adverse effects of solid wastes including human disease, animal disease, flies, rodents, insects, plant disease and crop damage, safety hazards, toxicity hazards, and the esthetic factors of odor and unsightliness. It becomes readily apparent that no one person, experienced though he may be, has at his fingertips sufficient knowledge of all the environmental fields listed above to properly assess their effects as created by any combination of solid wastes in any condition. Hence, the use of a large number of environmental scientists and engineers with expertise in the above fields to provide value judgments that could then be used in a systems analysis approach to the development of an integrating device for this purpose.

The study was undertaken on the hypothesis that environmental improvement can be expressed in terms of the degree to which any postulated management system decreases the environmental degradation or bad effects of solid wastes. The performance scoring procedure developed in this program provides quantitative bad effect scores for unit quantities for each type of waste when placed in any of the considered conditions. Without the innovation measuring methodology developed in this study, it is probable that several important factors would have been overlooked in determining a possible solution to the region's solid waste management problems. For example, more than 2/3 of the environmental effects in the Fresno Region are caused by only three categories of solid wastes; almost 1/3 of the municipal region's environmental problems are created by on-site storage; contrary to popular belief, sanitary landfills cause more problems in an agricultural region than in a municipal region.

The magnitude of the solid waste problem can more readily be envisioned when it is recognized that in the Fresno Study Region, with a population of 396,000, almost 2-1/2 million tons of solid waste is being generated each year. By the year 2000, when the region's population is expected to exceed 1 million, the rate of solid waste production is expected to increase to over 5-1/2 million tons per year.

Three major categories of wastes, mentioned above, i.e., organic municipal refuse, organic industrial refuse, and animal manures, constitute almost two-thirds of the total amount of solid wastes generated within the Fresno Region, and in addition, because of their highly putrescible nature, produce an even greater amount of the deleterious environmental effects. It was, therefore, particularly necessary to devise a possible solution that would provide major improvements in managing the three categories of gross environmental pollutants and to develop better storage techniques in the municipal subregions.

Any reasonable postulated system for the study region would automatically delete open burning and open dumping because of their atmospheric and land polluting effects. Recommendation of a system that utilized sanitary landfilling totally, although quite effective, would require increasingly larger landfill sites to accommodate the increasing projected rate of waste production. Additionally such a solution would pay insufficient attention to the long-range aims of conservation of our natural resources. Furthermore, it is highly desirable that any proposed solution be amenable to salvage operations when they become economically feasible and that as much as possible of the wastes be recycled as useful products to the region's economy. Another highly desirable objective was the built-in capability of allowing for an orderly transition from the existing system to that being proposed. Additional restraints on solution concepts included the region's projected economic capacity as well as legal, political, sociological, and practical factors.

Solutions involving long distance hauling of the wastes to points outside the region were considered to be highly impractical since they transfer the Fresno problem to another region. Had the study encompassed the entire

San Joaquin Valley, or even a major portion thereof, such solutions might have been evaluated in depth.

SELECTED SYSTEM

Figure A-1 is a schematic diagram of a proposed solid waste management system that could serve the Fresno Region for the year 2000. The system permits phased implementation and provides for application of new technology.

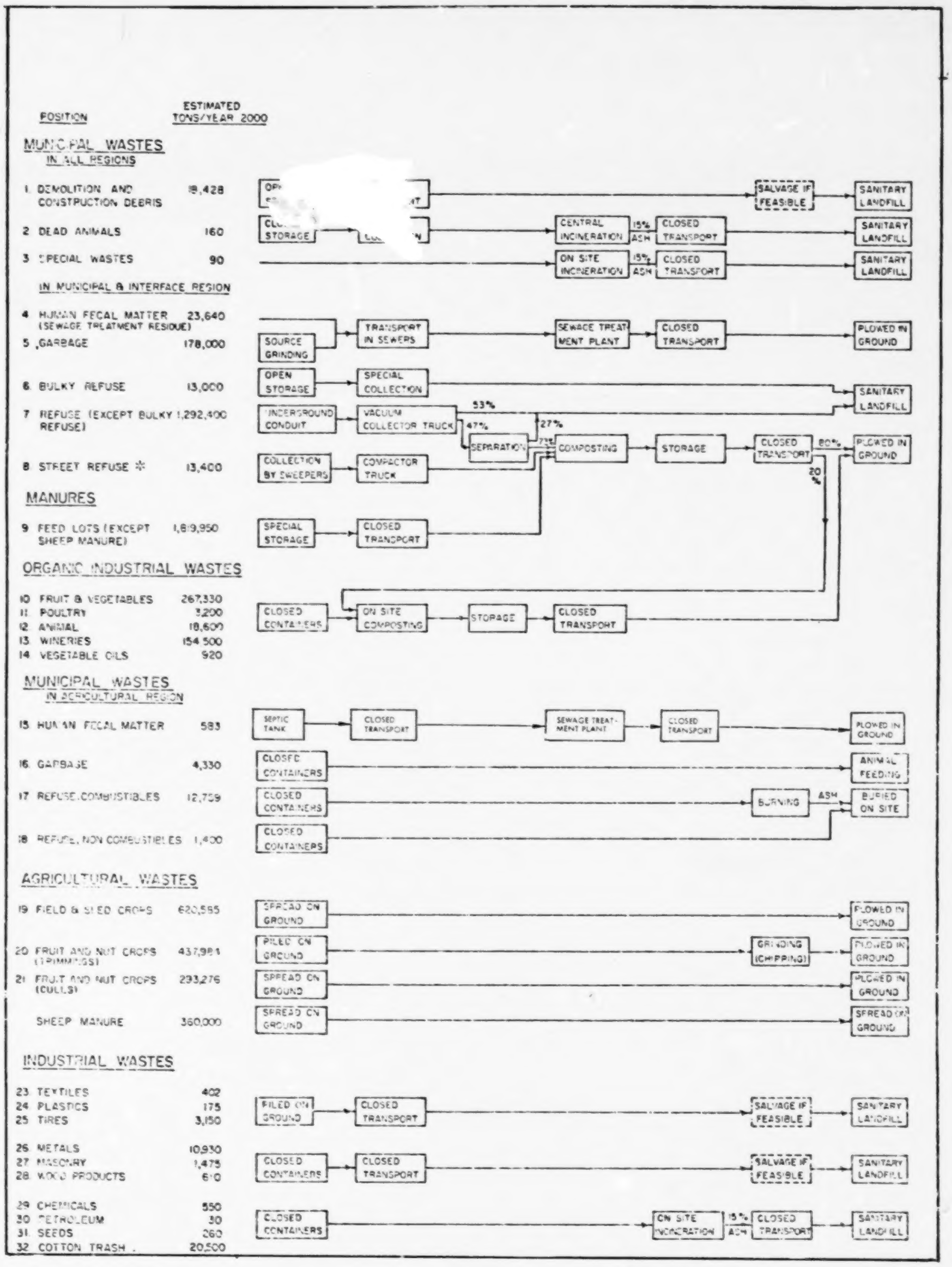
A. MUNICIPAL WASTES

Refuse produced in the residential-commercial areas of major communities in this study area would be stored in containers amenable to automated pickups, thus the vehicle which serves these areas would be equipped with the necessary devices such that it simply stops at a collection point, evacuates the container and passes to the next collection point (see Figure A-2). The operation of this equipment would permit a significant redistribution of personnel currently required to staff the collection service and reduce materially the environmental effects of ineffective source storage.

The loaded vehicle, as now planned, would take a large fraction of the refuse to a well-operated landfill for ultimate disposal. The balance of the refuse, as selected by characterizing loads from particular areas, with respect to compatibility with the composting of manures, would be transported to a composting plant for processing prior to final disposal as a soil conditioner and supplier of trace minerals. Those materials which are noncompostable would be separated and transported from the composting plant to the landfill for ultimate disposal.

B. INDUSTRIAL WASTES

Since industrial wastes are highly specialized and relatively small in quantity it is expected that many of these wastes would be stored in closed containers capable of automated collection at the source with closed vehicular transport to the landfill for final disposal. In some cases, this is the current practice but in too many instances controlled source storage is


POSITION
ESTIMATED TONS/YEAR 2000
MUNICIPAL WASTES IN ALL REGIONS
1. DEMOLITION AND CONSTRUCTION DEBRIS 18,428
2 DEAD ANIMALS 160
3 SPECIAL WASTES 90
IN MUNICIPAL & INTERFACE REGION
4 HUMAN FECAL MATTER (SEWAGE TREATMENT RESIDUE) 23,640
5 GARBAGE 178,000
6 BULKY REFUSE 13,000
7 REFUSE (EXCEPT BULKY REFUSE) 1,292,400
8 STREET REFUSE * 13,400
MANURES
9 FEED LOTS (EXCEPT SHEEP MANURE) 1,819,950
ORGANIC INDUSTRIAL WASTES
10 FRUIT & VEGETABLES 267,330
11 POULTRY 3,200
12 ANIMAL 18,600
13 WINERIES 154 500
14 VEGETABLE OILS 920
MUNICIPAL WASTES IN AGRICULTURAL REGION
15 HUMAN FECAL MATTER 583
16 GARBAGE 4,330
17 REFUSE COMBUSTIBLES 12,739
18 REFUSE, NON COMBUSTIBLES 1,400
AGRICULTURAL WASTES
19 FIELD & SEED CROPS 620,565
20 FRUIT AND NUT CROPS (TRIMMINGS) 437,981
21 FRUIT AND NUT CROPS (CULLS) 293,276
SHEEP MANURE 360,000
INDUSTRIAL WASTES
23 TEXTILES 402
24 PLASTICS 175
25 TIRES 3,150
26 METALS 10,930
27 MASONRY 1,475
28 WOOD PRODUCTS 610
29 CHEMICALS 550
30 PETROLEUM 30
31 SEEDS 260
32 COTTON TRASH 20,500
STORAGE
SALVAGE IF FEASIBLE
SANITARY LANDFILL
CENTRAL INCINERATION
15% ASH
CLOSED TRANSPORT
ON SITE INCINERATION
SOURCE GRINDING
TRANSPORT IN SEWERS
SEWAGE TREATMENT PLANT
PLOWED IN GROUND
OPEN STORAGE
SPECIAL COLLECTION
UNDERGROUND CONDUIT
VACUUM COLLECTOR TRUCK
53%
47%
27%
73%
SEPARATION
COMPOSTING
80%
20 %
COLLECTION BY SWEEPERS
COMPACTOR TRUCK
SPECIAL STORAGE
CLOSED CONTAINERS
ON SITE COMPOSTING
SEPTIC TANK
ANIMAL FEEDING
BURNING
ASH
BURIED ON SITE
SPREAD ON GROUND
PILED ON GROUND
GRINDING (CHIPPING)
SPREAD ON GROUND

*Leaves (only) to composting; dirt and sand to landfill

Figure A-1. Proposed Solid Waste Management System (Fresno Region)

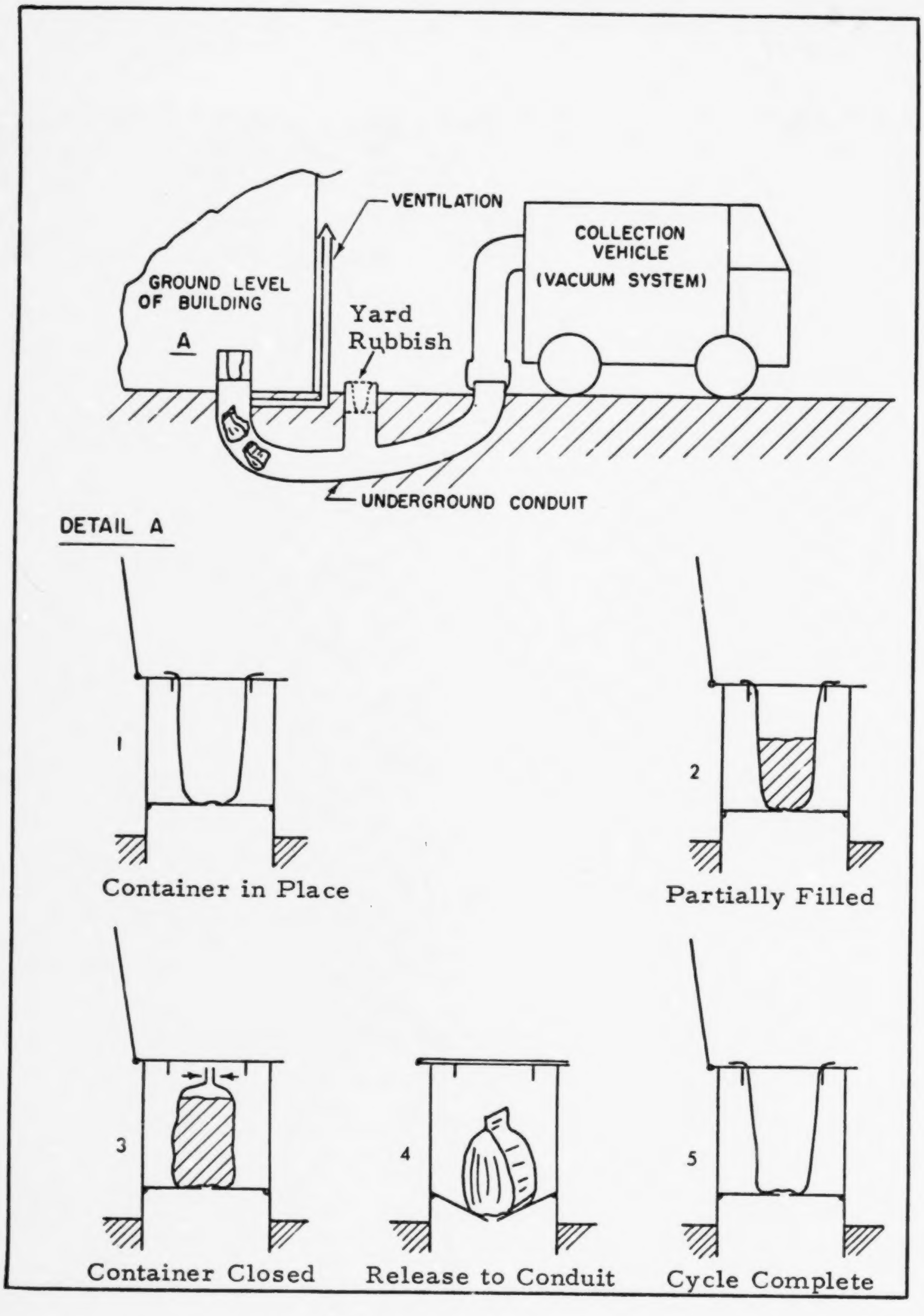

VENTILATION
GROUND LEVEL OF BUILDING
A
Yard Rubbish
COLLECTION VEHICLE (VACUUM SYSTEM)
UNDERGROUND CONDUIT
DETAIL A
1
Container in Place
2
Partially Filled
3
Container Closed
4
Release to Conduit
5
Cycle Complete

Figure A-2. Municipal Refuse: Storage in Underground Conduits and Automated Pickup by Vacuum System lacking and esthetically objectionable conditions often result; particularly in the case of putrescible materials. Efforts should be made to encourage maximum salvage at the source.

Organic industrial wastes (cannery wastes) would be processed by on-site composting. A portion of the compost produced by the municipal refuse-manure composting operation would be required for use as C/N ratio control and as a dry absorbent for these wet wastes.

C. AGRICULTURAL WASTES

The future of Fresno appears to include a very large cattle feeding industry; hence, the rate of production of manures from this industry and dairying places a large burden on the environment. The suggested system provides for combination of these manures with refuse materials high in hydrocarbons shifting the balance of the carbon nitrogen ratio such that the production of high quality compost is feasible. Efficient feedlot cleaning and closed trucking to the compost plant would eliminate most of the present problems of odors and flies. After the composting process is complete the product would be relatively stable; hence, it would be possible to store the composted materials during the non-growing season. This would also do much to relieve the often serious fly problem created by the management of these manures.

D. DISCUSSION

The proposed system meets all the objectives previously described. The three categories of highly putrescible wastes would be treated effectively; the system is amenable to salvage and would result in the production of 1,143,000 tons per year of compost useable as soil conditioners for parks, roadways, and agricultural lands as well as for saline and hardpan land reclamation; the proposed system of underground storage and vacuum collection in the municipal subregion would almost entirely eliminate a major portion of municipal bad effects, i.e., source storage. The system summarized above readily lends itself to future expansion and utilization of envisioned technological advances. Consideration has also been given to the maximum use of present operations to effect an orderly and efficient transition.

If adopted, the proposed system in the year 2000 would reduce the environmental effects scores of municipal and industrial wastes by about 84 percent and the effects scores of agricultural wastes by about 70 percent. The system would cost approximately $78,000,000 (1967 value dollars) to handle the waste resulting from the projected increase in the region's population compounded with the projected increases in per capita municipal and industrial waste production.

Few people recognize the need for and the financial requirements of solid waste management. As national recognition of this need increases with time, it is probable that the cost requirement, even when related to existing spending levels, will appear conservative in the light of what people will be willing to spend in the future. It does, however, appear that to successfully anticipate the availability of funds to implement new or improved solid waste systems, new entities need to be created to make available a uniform system of funding.

Any plan that is optimum from the standpoint of solid waste management should seek to balance conflicts between governmental concern and private enterprise, the desires for regional uniformity and the demands for local autonomy, the guaranteed freedoms of individual activity, and the permissible scope of government regulation and control. The regional solution may be adequately configured to achieve most of the benefits of total governmental control while allowing the participation of private industry where appropriate. Through this approach, the desired levels of uniformity, the economies of scale, and the augmentation of the operations with the aid of private entreprenurial skills could be blended.

It must be emphasized, at this point, that the above suggested solution to the solid waste management problems of the Fresno Region is applicable strictly to that region. The approach to the solution may be used for other similar regions but the actual solution is pertinent only to the Fresno Region.

ENVIRONMENTAL EFFECTS EVALUATION

A. PERFORMANCE SCORING

The performance scoring procedure, developed by utilizing systems analysis techniques, provides a technical-economic selection process far superior to that of individual judgment. While the mathematical routines used in the scoring procedure are quite simple, the number of wastes, bad effects, and conditions of wastes resulted in the necessity for handling and manipulating some 25,000 bits of numerical data. Hence, a computer program was developed and a digital computer used to perform the calculations and provide printed tabulations of the results. The performance scoring procedure, as presently constituted, allows for an ordering of solid waste management systems in terms of relative performance and not in absolute performance. As more quantitative scientific data relating environmental effects to solid wastes becomes available and is applied to the procedure, the relative scores will more nearly approach absolute. Even in the event of future perfection of the technical-economic process, the legal, political, and administrative decisions, representing local awareness of public acceptance, would still be required. However, the decisions obtained by cognizant officials will be easier and better because of this improved selection process.

Since the performance scoring procedure is based largely on the judgment values of environmental scientists and engineers, it is of interest to note the sensitivity of the scoring procedure to differences in judgment values. To test this sensitivity, the bad effects score for flies, engendered by cattle manure in closed storage containers in an industrial zone was hypothetically increased from the 2.7, determined by the panel of experts, to 3.7. The system assumed was the proposed system for the year 2000, wherein the manure would, after maximum storage of 7 days, be transported by closed vehicles for composting. The result of this 37 percent change in a major bad effect score for a major waste component was a 1.16 percent change in system regional performance, indicating that the performance scoring procedure is not adversely affected by minor judgment errors in basic bad effect scores.

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B. ANCILLARY EFFECTS SCORING

Two totally different systems may have exactly the same effect on maintaining a desirable environment when consideration is given only to solid wastes. They may differ dramatically, however, in the manner that the physical objects constituting the management system interact with their environment. The ancillary effects scoring procedure was developed as a means of measuring the physical, social, and psychological effects of alternate waste management systems and their components as opposed to the effects of solid wastes themselves. This procedure becomes important in system selection when competing wastes management systems exhibit similar cost and effectiveness characteristics.

CONCLUSIONS

During the performance of this study, the participants maintained continuous contact with the state project administrator and the local city and county officials and administrators. This direct contact provided a free interchange of ideas and thoughts, making possible a much clearer understanding by the participants of local administrative problems. The establishment and maintenance of this relationship provided the information needed for the application of systems analysis to the socio-economic problem under consideration.

During the course of this study, the city and county governments instituted many improvements in the existing solid waste management system. Some of these steps were taken as a direct result of the June 1967 Interim Report; others developed from direct consultation during the study, or from independent action. Examples include an ordinance requiring twice-a-week collection of garbage between May and November; prohibiting open burning at dump sites; the voluntary merging of nine individual private operators into a single large collection and disposal company.

A complete section of the report is devoted to describing the parameters and limitations to be considered in synthesizing management systems for the Fresno Study Region. It was concluded, however that the principal limitation to the initiation of virtually any proposed solid waste management system is, in reality, a function of the communities desire to reduce the adverse environmental effects of solid wastes. By the judicious use of legislation in combination with adequate funding almost any desired degree of freedom from deleterious environmental effects is attainable. As the affluence of our society increases, discretionary income will be distributed to various markets. Improved waste management systems should be among those markets. Continued increase of home garbage grinders demonstrates that people are willing to spend a greater portion of their income to enhance convenience in handling solid waste and to improve their environment. Their willingness to pay will be based on their understanding and knowledge of the extra convenience and environmental improvement that can be attained by a properly planned solid waste management system.

While the procedure developed in this study is still subject to refinement, it is a significant step in the direction of the development of a methodology whereby the environmental effectiveness of competing waste management systems can be measured for use in a systems approach to cost-benefit analysis.

I. INTRODUCTION

This study was undertaken to develop a plan for the management of solid wastes in a rapidly urbanizing agricultural region of California on the premise that solid waste management involves such complexities and interdependencies that a sophisticated and systematic approach is needed if more than immediate and partial solutions are to be achieved.

The prime objectives of this study were (a) to determine an optimum solution to the solid waste management problems of a specific region (the Fresno area), and (b) to develop a technology for study of the region that could be applied to solve solid waste management problems in other similar regions. Accomplishment of these objectives required the performance of three essential elements of work in such a manner that the methodology and the experience gained in its application might be readily applied elsewhere. These elements were:

- The development and documentation of a method of measurement by which the effectiveness of any system or means of managing solid wastes might be evaluated and compared with alternative systems in terms of the extent to which they solve the health, air, water, and land pollution, socio-economic, esthetic, and other problems engendered by solid wastes.
- An assessment of the effectiveness of the region's present solid waste management system and the concomitant identification of the magnitude of the present problem by means of the method of measurement, including an estimate of future problems if appropriate action is not taken now or in the near future.
- An evaluation of alternative systems by means of the method of measurement to identify the solution that will best provide, at reasonable cost, a solid waste management system for the study region.

The basic plan covered five major sequential steps. The first step developed a measure by which alternative proposed systems could be evaluated against a common criterion, so that superior systems could be recognized.

The second step concentrated on the conceptual design of potentially good, alternative, solid waste management systems. The performance score and cost of each alternative was identified in the third step. The fourth step compared the alternatives in terms of performance score and cost and other important factors to determine which alternative should be chosen for implementation. The fifth and final step of the study considered the data and methods developed for the study region to determine how they might be best applied to help solve solid waste management problems in other similar regions.

The eighteen-month effort has developed data and methods reported herein and encompassing:

A. Identification of the solid wastes in the study region and the problems created, and identification of the groups, agencies, and agency representatives affected by these problems.

B. A procedure for measuring the effectiveness of any proposed system or means for managing solid wastes in the region in terms of the extent to which it solves solid waste problems.

C. Identification of the conditions under which any solid waste management system for the region must operate, including waste loads projected to the year 2000; regional topographical, geological, climatological hydrological, economic, and demographic data; projected land use, laws, and policy criteria; technical and cost data; and jurisdictional relationships.

D. Conceptual designs of alternative systems for the management of solid wastes in the region.

E. Provision of itemized and charted data relative to estimated performance score ranges and costs of each alternative system concept considered, plus a list of application scores reflecting any adverse or beneficial effects the various systems would impose on the environment in which they would operate.

F. Provision of a rationale for the ranking of the alternative system concepts, with specific attention to the rationale for the highest ranking system for the study region.

G. A detailed description of the concept recommended for use in long-term management of solid wastes in the region, plus recommendations for immediate action to alleviate current problems (including legal, quasi-legal, jurisdictional, political, and financial considerations).

H. Generalization of the findings and procedures so they may be applied to similar regions.

I. Background data pertinent to the main body of the final report not previously published in the interim report.

J. Recommendations for further study and research needed to develop future techniques to solve problems for which current techniques are inadequate technically or economically.

A map of the Fresno Region study area is presented in Figure I-1.

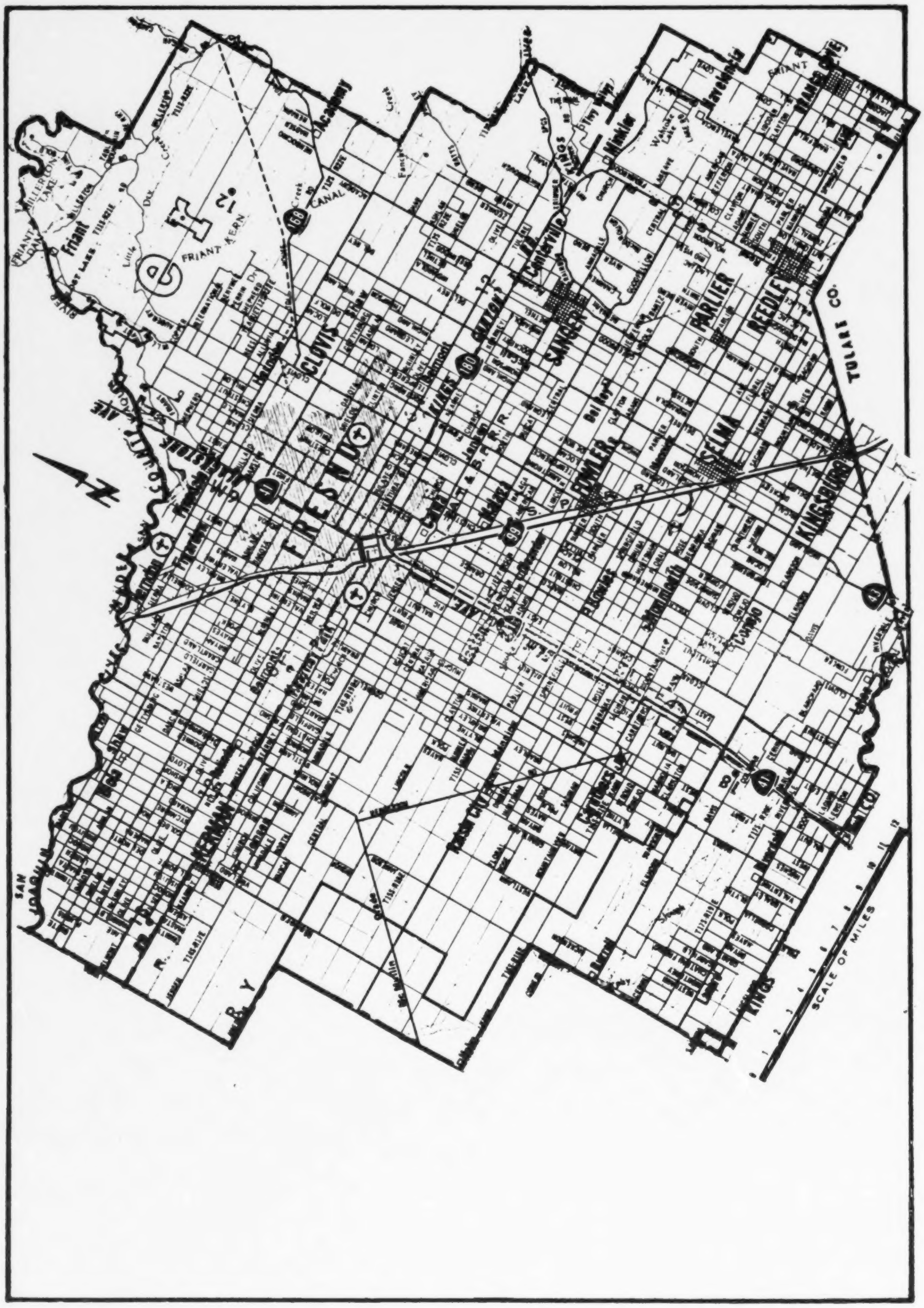

Friant
FRIANT KERN
CANAL
CLOVIS
FRESNO
SANGER
Centerville
Minkler
PARLIER
REEDLEY
SELMA
FOWLER
KINGSBURG
TULARE CO.
KINGS
SAN JOAQUIN
SCALE OF MILES

Figure I-1. Fresno Region Study Area

II. SUMMARY AND RECOMMENDATIONS

A. STUDY OBJECTIVES

The problems of waste management that have plagued mankind from time immemorial have quite recently received new and significant attention at local, State and Federal Government levels. As a result, there has been a considerable increase in the study and research of waste management problems and practices. However, much of the newly available support has gone into the study and research of air and water pollution, with less effort being devoted directly to the field of solid waste management. Accordingly, the technology of solid waste management remains one of the least developed within the waste management field.

A great need exists for basic improvements in solid waste technology as well as a wider application of currently available advanced techniques. The application of new methods and techniques should be cost-effective so that use of community resources will be managed as efficiently as possible.

A major handicap to the orderly development of more effective management in the solid waste field has been the lack of adequate criteria by which to measure present and future solid waste problems and evaluate the effectiveness of proposed solid waste management systems. As a result, there is much uncertainty regarding the extent of today's solid waste management problems, as well as the problems of tomorrow. Society is headed toward increasing complications in solid waste management, and only by continuing and persistent efforts in the pioneering of new methods will it be possible for solid waste management to keep pace with anticipated new developments for community development.

The State of California, with support of the Solid Wastes Program of the U.S. Public Health Service, selected Aerojet-General Corporation and Engineering-Science, Inc., to study the problem on a real-world scale in a typical urban-agricultural region in and about Fresno, California. This study had two principal objectives. These were to determine an optimum solution to the Fresno Region solid waste management problems and develop a technology for study of the Fresno region that may be applied to solve solid waste management problems in other similar regions.

Accomplishment of these objectives required the performance of three essential elements of work in such a manner that the methodology and the experience gained in its application might be readily applied elsewhere. These elements were:

1. The development and documentation of a method of measurement by which the effectiveness of any system or means of managing solid wastes might be evaluated and compared with alternative systems in terms of the extent to which they solve the health, air, water, and land pollution, socioeconomic, esthetic, and other problems engendered by solid wastes.

2. An assessment of the effectiveness of the region's present solid waste management system and the concomitant identification of the magnitude of the present problem by means of the method of measurement, including an estimate of future problems if appropriate action is not taken now or in the near future.

3. An evaluation of alternative systems by means of the method of measurement to identify the solution that will best provide, at reasonable cost, a solid waste management system for the study region.

This section summarizes the results and conclusions of the study and provides recommendations for follow-on efforts.

B. OPERATING CONDITIONS

Prior to synthesizing an effective system for the Fresno region, it was necessary to establish the conditions under which such a system would be required to operate. These conditions include:

Regional Physical Environment

Population (Existing and Projected)

Land Use (Existing and Projected)

Waste Loading (Existing and Projected)

Legislative Conditions

Existing Management Practices

Economic Capacities and Projections

State Department of Health Guidelines

Technical Restrictions

1. Regional Physical Environment

a. Location and Topography

The Fresno Region study area is the central portion of Fresno County as shown on the location reference map, Figure II-1. It is approximately 48 miles east to west and 35 miles north to south and contains about 770,000 acres. The area is shown in greater detail on Figure II-2.

The area is located in the flat section of the San Joaquin Valley and is drained by the San Joaquin and the Kings Rivers. The region does not exhibit pointed topographical variations from one location to the other. The general slope of the land follows a slight westerly decline of 4 to 5 feet per mile in the area east of the Fresno Slough, where it changes direction and exhibits a gradual westerly rise toward the coastal mountain ranges. Elevations in the region vary from a minimum of 110 feet to a maximum of about 500 feet above sea level.

The region contains the metropolitan area of Fresno and Clovis, the cities of Sanger, Fowler, Selma, Reedley, Kingsburg, Parlier, Kerman, and Orange Cove, as well as the unincorporated communities of Caruthers, Riverdale, Easton, Biola, Del Rey, Laton, Calwa, Herndon, Malaga, Raisin City, and others.

b. Climate

The area is subject to hot, dry summers and moderate winters. The coast ranges insulate the valley from the modifying effect of the Pacific Ocean and, hence, the summer temperatures reach

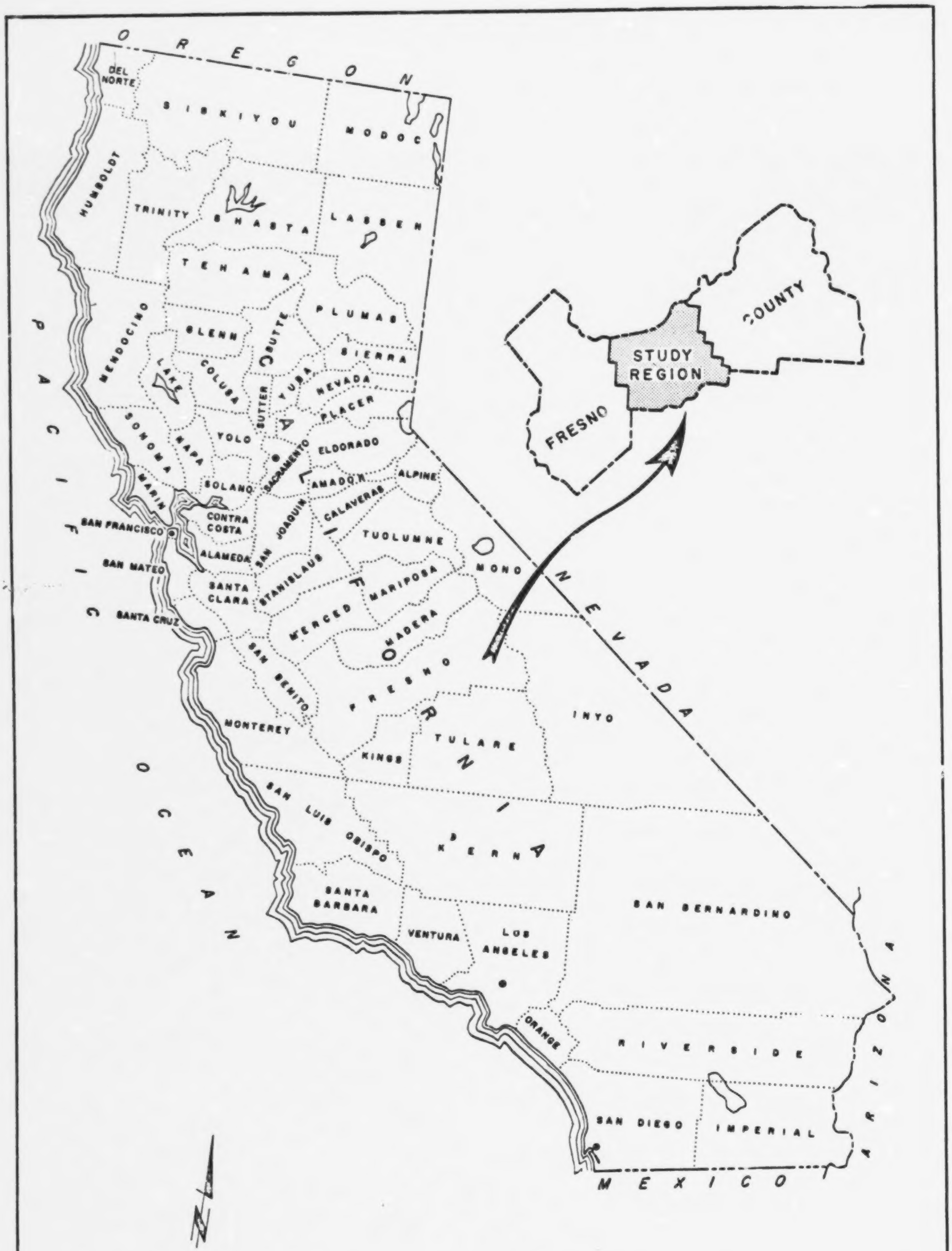

OREGON
DEL NORTE
SISKIYOU
MODOC
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
LAKE
COLUSA
YUBA
NEVADA
SUTTER
PLACER
SONOMA
NAPA
YOLO
SACRAMENTO
ELDORADO
MARIN
SOLANO
AMADOR
ALPINE
SAN JOAQUIN
CALAVERAS
CONTRA COSTA
SAN FRANCISCO
TUOLUMNE
ALAMEDA
MONO
SAN MATEO
STANISLAUS
SANTA CLARA
MARIPOSA
SANTA CRUZ
MERCED
MADERA
SAN BENITO
FRESNO
INYO
MONTEREY
TULARE
KINGS
SAN LUIS OBISPO
KERN
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
MEXICO
ARIZONA
NEVADA
CALIFORNIA
PACIFIC OCEAN
COUNTY
STUDY REGION
FRESNO
N
50 0 50 100
SCALE IN MILES

Figure II-1. Location Reference Map of Study Region

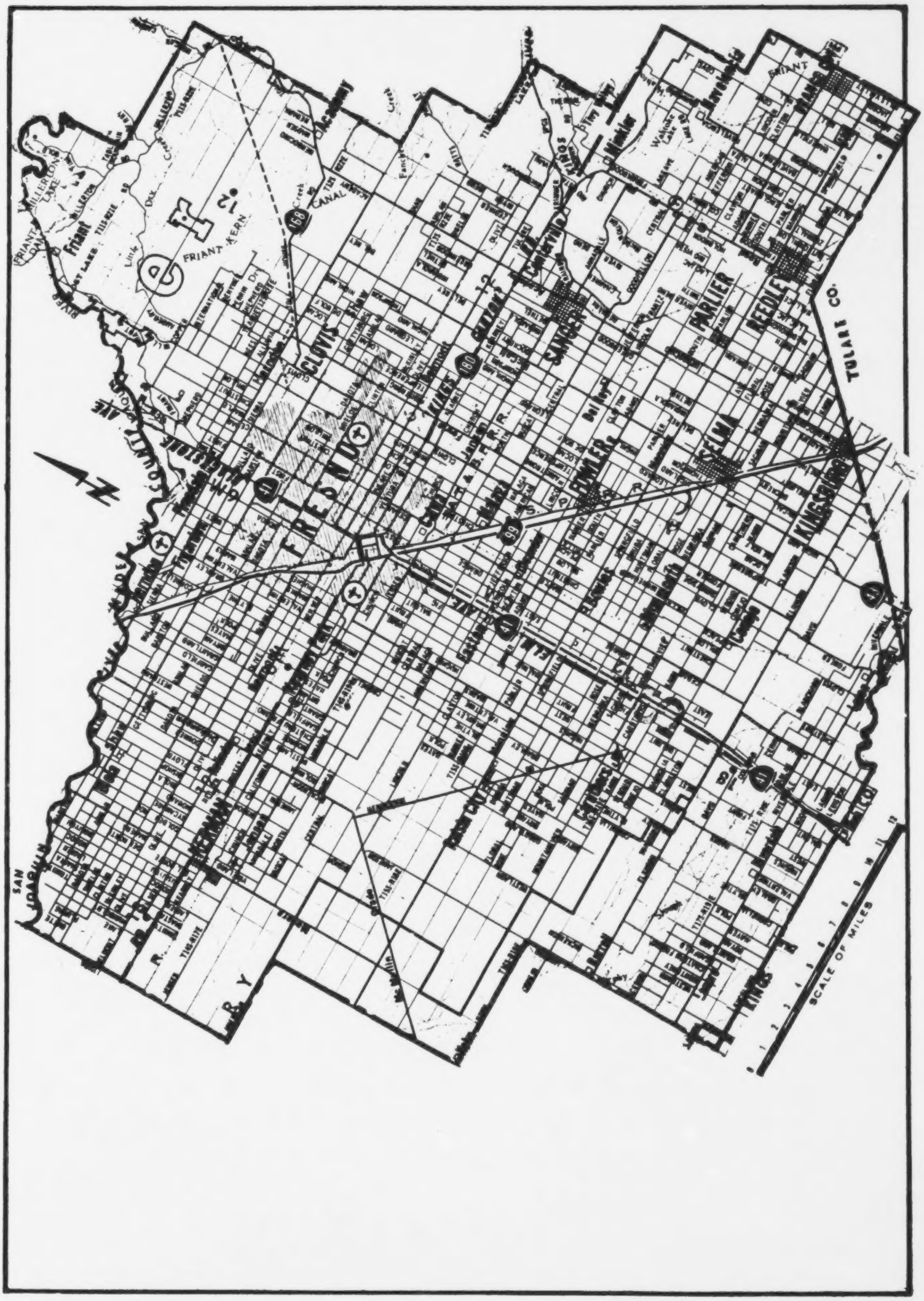

MILLERTON LAKE
Friant
FRIANT-KERN CANAL
CLOVIS
FRESNO
SANGER
FOWLER
SELMA
PARLIER
REEDLEY
KINGSBURG
TULARE CO.
SAN JOAQUIN
KINGS
SCALE OF MILES

Figure II-2. Fresno Region Study Area

extremes found in mid-continental locations.

The July daily maximum temperatures average over 100°F with maximums reaching 115° and higher. The January mean daily minimum temperature is above freezing (33° -34°F) with frost occurring only a few nights per year.

Rainfall in the valley results from winter storms that move onshore from Pacific low pressure systems, dropping their moisture in the San Joaquin Valley. Precipitation in the study region averages less than 15 inches annually with some local regions receiving no more than 6 to 7 inches. The rainfall is concentrated in the winter with nearly 85 percent of the annual totals falling in the six-month period from October through March.

The meteorological conditions in the area are unusually favorable for the development of air pollution. While air pollution is not yet a major problem throughout the region, local air pollution situations occur over a considerable area. These are the result of dust, smoke, odors and specific chemicals. During the fall the burning of agricultural wastes is a significant factor in the region's air pollution problems.

c. Hydrological

There are two main surface streams in the Fresno region, the San Joaquin and the Kings Rivers. The San Joaquin, gaged below Friant, has a 58-year average discharge of 1,669,000 acre-ft/yr. The Kings River at the Pine Flats Reservoir has a 12-year average discharge of 1,439,000 acre ft/yr. Both of these rivers have water of excellent quality, containing less than 50 parts per million of dissolved solids.

Groundwater, however, is the main source of water supply in the Fresno region for municipal, domestic and industrial water. Agricultural water requirements are also supplemented by the use of groundwater; with groundwater being the only source of supply in some areas.

Groundwater is found throughout the region, but the accelerated usage rates of recent years have lowered the depth to groundwater in the Fresno-Clovis Metropolitan area an average of 3 feet per year. In general, the groundwater quality in the region is good, except for a few local areas where pollution in the past from a zeolite plant, an ice plant, and a sewage treatment plant has resulted in a lowering of water quality.

2. Population-Existing and Projected

The population in the region in 1967 was approximately 396,000. Of this population about 312,000 resided in the region's communities and 84,000 in areas outside the communities. By the year 2000 the region's population is expected to exceed 1,000,000. The entire regional increase will probably occur in the cities and communities with the population outside the communities remaining practically static. The distribution of population in the year 2000 is projected to be 973,000 in communities and 83,000 outside.

3. Land Use

Agriculture is by far the largest land use in the region. Of the 770,000 acres in the Fresno Study Region, 43 percent (329,000 acres) are presently producing high-return crops such as fruits, nuts, field crops, and vegetables. Another 39 percent (300,000 acres) is used for irrigated pasture, alfalfa, hay, or native rangeland, leaving about 52,000 acres under urban development and the balance vacant (89,000). By the year 2000, 585,000 acres are expected to be producing high-yield crops with 111,000 acres under urban development. The remaining 74,000 acres will be almost totally utilized for alfalfa, hay, and pasture.

4. Waste Loadings

Solid wastes in the Fresno region are currently being generated at the rate of 2,477,000 tons per year. This quantity is made up of 432,000 tons of municipal wastes, 256,000 tons of industrial waste, 1,012,000 tons of animal wastes and manures, and 777,000 tons of crop residues. By the year 2000 the rate of waste production in the region is expected to reach

5,582,000 tons per year with 1,529,000 tons of municipal, 508,000 tons of industrial wastes, 2,130,000 tons of manures, and 1,365,000 tons of crop residue wastes.

5. Legislative Controls

In general, laws and ordinances dealing with solid waste management in the Fresno region fall into three categories: state legislation, county ordinances and municipal legislation.

State legislation for the most part is enabling in nature. It provides broad-procedural bases for undertaking solutions to solid waste problems, and specifies a variety of administrative configurations to manage and control these activities. Most of the state legislation for solid waste management is found in the Health and Safety Code.

County ordinances on waste management are implementing in nature, and develop detailed methods to meet the control objectives. The majority of county ordinances dealing with solid waste management can be found in Chapter 3 of the Fresno County Ordinance Code.

Municipal legislation is directed toward detailed definition of methods, techniques and financing of the collection and disposal of solid wastes. In the City of Fresno, the group of ordinances in the code pertaining to solid waste management are contained in Article IV of the Municipal Code.

6. Resulting Practices

The result of existing policies has produced a heterogeneous system in the Fresno region, with practices varying between county and city, and between cities. There is no standardization of equipment or routines and, until recently, a great deal of route duplication resulted. Recently, nine independent companies combined into a single firm to supply services to the area encompassed by the zones of the former companies. This is a great step forward in eliminating duplication of services.

Much of the problem of poor equipment and overlapping service in the private sector is probably due to the ease with which anyone can get a permit and set up a rubbish collecting business. The lack of vested property rights interest, such as would be produced by long-term franchise contracts, militates against the investing of sufficient capital to buy and maintain the better and more efficient equipment. In addition, franchise systems, limiting the collector's zone of operation, would help eliminate costly duplication of services.

7. Economic Capacities and Projections

The present economy of the Fresno study region is based largely on agriculture. However, a number of durable and nondurable goods industries exist in the region in addition to those agriculturally based. The City of Fresno is the region's commercial center and a significant part of the economy is based on retail and wholesale trade. Industry, in the future, is expected to become wider based, although agriculture will continue to be of major importance in the year 2000. The commercial trade and service industries are expected to expand as the population increases.

Regional per capita income of $2800 is expected to increase to $6100 by the year 2000. The increase in per capita income, combined with the expected population increase, will result in a regional income of 6.5 billion dollars by the year 2000 as compared to the present 1.1 billion. Although per capita income is likely to increase about 118 percent, the cost of living, as indicated by extrapolations of the consumer price index, is also expected to rise by approximately 76 percent. The net result will be 42 percent more real disposable income. Increased affluence, combined with a specific education effort is expected to motivate the residents toward an improved environment that would require approximately doubling the current one percent of regional income expended for solid waste management. Another aspect of economic growth is the region's assessed valuation. At present this valuation is approximately 608 million dollars, but if the valuation increases in proportion to income, in the year 2000 it will have increased to 4.0 billion dollars. This would provide a substantial base for short-term bonding to acquire adequate facilities as expansion becomes necessary.

8. State Department of Health Guidelines

At the present time the State Department of Public Health guidelines on handling and disposal of solid wastes have not been published. However, the preliminary criteria recommending maximum source storage periods for various types of municipal, agricultural and industrial wastes were made available and have been used in this study.

9. Technical Restrictions

A great many systems and techniques are available for unit processes associated with waste management. The major restrictions to application of most of the available and many of the advanced techniques is, simply, cost.

Waste management systems can usually be broken into five major function or unit processes. These are storage, collection, transportation, processing and disposal.

Storage is accomplished by three basic systems: manufactured portable containers, constructed-in-place containers, and open storage areas. Costs for the storage function range from \$2.00 to \$120.00 per cubic yard of storage capacity per year. The median cost ranges from \$8.00 to \$22.00

Collection methods include hand portable equipment, powered vehicular systems, pneumatic equipment systems, pipelines, conveyor belt systems and gravity water transport. While all the above systems have proven feasibility, many problems still exist in the categories of pneumatic equipment, pipelines, and conveyor belt systems. The reported collection costs for municipal refuse range from \$8.00 to \$25.00 per ton, with the median range in the area of \$10.00 to \$16.00 per ton. The extremes in cost are the result of variations in local labor costs, types of equipment used, and degree of service supplied.

Transportation systems can be motor transport, pneumatic systems, conveyor belt systems, rail transport, pumped slurry transport, and gravity waterborne transport.

Transfer stations are also considered part of the transportation function. The limitations of similar systems used for the collection function, of course, apply equally to transportation. Some typical solid waste transport costs are 6 to 10¢ per ton mile for motor transport. Rail transport costs, where available, would be about 0.8¢ to 1.0¢ per ton mile, and transfer station operations cost 35¢ to $2.60 per ton handled.

Processing methods for solid waste include combustion, chemical oxidation, biological degradation, physical size and volume reduction, and separation for salvage. The technical problems involved in implementing any of the above systems present no great difficulty. Major problems involve air pollution in combustion systems, odors in composting, and the fact that salvage-oriented systems are presently economically marginal. Cost for incineration is between 4 and 10 dollars per ton, wet oxidation 4 to 30 dollars per ton, composting 4 to 15 dollars per ton, and central garbage grinding 0.90 to 1.40 dollars per ton. If salvage is combined with pulverization, costs are increased to 4 to 5 dollars per ton.

Disposal is the ultimate step in a community's solid waste management system. The major methods practiced are sanitary landfilling, open dumping, open burning, ocean disposal, atmospheric disposal by incineration, land spreading and animal feeding. All the above methods have been in general use for many years; pressure injection of slurries is currently being researched. The basic technical problems incident to the disposal systems are those of interface pollution with land, water, and air. The cost of disposal in the study region is $1.14 to $1.27 per ton for sanitary land filling, 50¢ per ton for open dumping, 45¢ to $2.90 per ton for land spreading, and 17¢ per ton for animal feeding.

The study developed detailed unit costs of all current processes and techniques as well as costs for advanced systems. These unit costs are the basis for the predicted total cost of postulated systems for the Fresno region.

C. PERFORMANCE AND ANCILLARY EFFECTS SCORING

To accomplish the major objectives of this study, it was essential that methodology be developed whereby the effectiveness of the various possible handling systems could be compared. The performance scoring and ancillary effect scoring procedures devised in this study are the result of applying systems analysis to the problem of integrating complex environmental relationships.

1. Problem Identification

The first requirement in devising a methodology for measuring the effectiveness of waste management systems in controlling environment effects is to identify the problems and effects to be controlled.

a. Definition of Solid Waste

The American Public Works Association categorizes solid wastes as refuse, including "... semi-liquid or wet wastes with insufficient moisture and other liquid contents to be free-flowing." However, the physical state of various wastes may undergo change during treatment or transport. The definition problem involves the inclusion of what might at one stage be classified as liquid waste, whether the solids are in suspension or solution, and at another stage as the combustion and evaporation products of wastes discharged into the air.

Consideration must also be given to wastes that potentially have value and may be returned to the useful economic cycle. Examples include animal manures, junked automobiles, and other wastes such as tin cans, glass, paper and cardboard which may be salvaged depending on market conditions.

On the basis of these considerations, the definition used in this report is as follows: solid waste is that normally solid material arising from animal or human life and activities and discarded permanently, or temporarily, as waste. It also includes deposited waste particulates temporarily suspended in air or water.

In the Fresno region, 82 different solid wastes were originally identified as occurring in sufficient quantities to create a problem. All these wastes were categorized by origin into three groupings, designated here as municipal, industrial and agricultural wastes. The list was finally reduced to 52 by combining certain similar wastes and eliminating others determined not to be of sufficient quantity to create serious environmental problems.

b. Conditions of Solid Waste

To further establish a basis for measuring environmental effects of solid waste it was necessary to determine all states and conditions in which solid wastes presently exist or are likely to exist in the Fresno region for the duration of the study period. After an extensive literature search and consultations with sanitary engineering and environmental health experts it was determined that the following represent all conditions in which solid waste is likely to occur in the Fresno region.

The conditions are:

(1) Unmanaged
(2) Spread on Ground
(3) Piled on Ground
(4) Piled on Slab
(5) Container Open
(6) Container Closed
(7) Transport Open
(8) Transport Closed
(9) Grinding
(10) Spray Irrigation
(11) Incineration

(12) Open Burning
(13) Composting
(14) Lagooning
(15) Landfill
(16) Buried
(17) Open Dump
(18) Plowed in Ground
(19) Pit Disposal

While it is not intended to imply that the above are the only possible conditions in which solid waste can exist, it is believed that all major conditions are included, and that the majority of methods and unit processes for handling solid waste can be accommodated by a broad definition of the conditions listed.

c. Environmental or Bad Effects of Solid Waste

The last item connected with problem identification was that of identifying the various environmental bad effects associated with solid wastes in the various conditions in which they can be placed. After consideration by environmental health experts, and an extensive review of the subject literature, it was determined that 13 bad effects need be considered. These are:

(1) Flies
(2) Water Pollution
(3) Air Pollution
(4) Rodents
(5) Human Disease
(6) Animal Disease
(7) Insects Other Than Flies
(8) Safety Hazards
(9) Odor

(10) Plant Disease
(11) Land Pollution
(12) Unsightliness
(13) Toxicity

2. Performance Scoring

In the waste management field in general, and particularly in solid waste management, there are few performance standards. The standards that have evolved are the result of emergency pressures and are directed almost entirely toward the alleviation of a disease potential or the removal of waste from direct sight and contact at the least possible cost.

The basis of the procedure advanced in this study is the postulation that effectiveness can be expressed in terms of the degree to which the system decreases the environmental or bad effects of the waste. If, for example, a unit quantity of a given waste lying open on the ground is the constant source of one unit of odor, a control system such as a tarpaulin cover that cuts this odor in half could be said to have a relative effectiveness of 50 percent, a tightly sealed container one of 100 percent. The procedure developed in this program resulted in a quantitative bad effect score for a unit quantity of each type of waste when placed in any of the 19 conditions considered above. The most effective system places the waste in conditions resulting in the lowest score.

a. Basic Bad Effects Scores

With the establishment of bad effects, waste conditions, and an inventory of different wastes produced in the region, basic bad effects scores were determined for each waste under each condition. This was accomplished by having experienced practitioners in the sanitary engineering and environmental health fields provide value judgements as to the relative contribution of a given waste under a given condition to possible bad effects. A rating scale of 0 to 5 was used, with 0 indicating no significant contribution and 5 the highest contribution. Scores or ratings for each bad effect for all the wastes contributing to that effect under all conditions were provided by several experts. The rating scale of 0 to 5 was used to obtain a finer relationship than good or bad and yet not exceed the practical limitation of subjective decision making.

Next, a relative condition rating that reflects the consequence on bad effects of placing a unit quantity of the combined wastes in each of the conditions was determined in a like manner with the same 0 to 5 rating scale, i. e., 0 indicates that the condition virtually eliminates the particular bad effect and 5 indicates the condition is the worst possible way of handling the waste. The two ratings were then multiplied and the resulting scores for a unit quantity of each waste for each bad effect under each condition were designated as basic bad effects scores.

b. Influence Coefficient

The basic bad effects scores still lacked two features necessary for actual application. First, the scores did not reflect the relative importance of the various bad effects in terms of the type of area or subregion where they occurred, i. e., whether the area was predominantly municipal, industrial, agricultural, or an interface area between municipal and agricultural. Secondly, the values did not consider the relative contribution to the generation of bad effects by solid wastes as compared to other contributors.

The relative importance factor for each subregion was determined by a two-step procedure. First, an order of importance was established by sanitary engineering experts using a method known as forced decision-making. One bad effect at a time was compared with each of the other bad effects and a 0-1 decision made as to their comparative importance. The more important effect was scored 1 and the lesser 0. The decisions were then added, resulting in a ranking of the 13 bad effect for each subregion. Numerical values representing the relative importance, on a scale of 0 to 100, were then assigned to each bad effect following the order determined above. The numerical values assigned were judgments by program and State personnel and are not necessarily proportional to the order of importance.

The relative contribution factor for each subregion was then established by sanitary engineers in conjunction with State and Fresno County officials. This factor represents a judgment as to what percent of each bad effect is caused by solid waste. For example, solid wastes are virtually the only contributor to fly breeding and therefore this bad effect received a value of 100, whereas solid waste contributes very little to human disease and was scored quite low for all subregions.

The influence coefficient for each bad effect in each subregion is the result of the multiplication of the relative importance factor by the relative contribution factor and the ratioing of the resulting product of each bad effect to the sum of products for all bad effects in all subregions.

c. Total Weighted Bad Effects Score

The final values required for the performance scoring procedure, i.e., the total weighted bad effects scores, were then obtained by multiplying the basic bad effects scores by the influence coefficient for each bad effect for each condition in each subregion and the resulting scores added for all bad effects in each particular condition. The final output of this procedure is a score representing the total bad effect of a unit quantity of a particular waste in a given condition in a particular subregion. Total weighted bad effect scores for each subregion were determined for all 82 wastes in each of the 19 conditions.

d. System Performance Scores

The performance score of any postulated waste management system is the sum of the total weighted bad effect scores for each waste in each condition in each subregion multiplied by the tonnage of each waste in the particular conditions called for by the system being considered.

Several of the conditions are basically transient, i.e., the wastes are in such conditions only for a short period of time. Compared with disposal conditions, in which the wastes attain a more or less permanent state, these transient scores are relatively low. Combining the two component scores would result in losing the effect of any improvement for transient conditions. Because it was judged that transient and disposal components are of equal importance to society, separate scores were maintained. In the final analysis of total system performance these two component scores are individually evaluated and the results combined.

3. Ancillary Effects

The ancillary effects scoring procedure was developed as a means of measuring the physical, social, and psychological effects of alternative waste management systems and their components as opposed to performance scoring of the effects of solid wastes. For example, a system that employs trucks to collect solid wastes from households creates noise, traffic interference, exhaust fumes, and is a safety hazard compared to an alternate method such as underground tubes. The ancillary effect scoring procedure becomes important when a number of systems under consideration have similar performance scores and costs. Ancillary effects can then be used to choose the optimum system from a group of nearly equal cost-effective systems.

a. Ancillary Effects Identification

The first step in developing the ancillary effects scoring procedure was the identification of effects to be scored. The problem was considered by environmental health experts and the following list selected:

(1) Noise
(2) Traffic Interference
(3) Land Pollution
(4) Odor
(5) Unsightliness

(6) Safety Hazards
(7) Air Pollution
(8) Water Pollution
(9) Legal Problems
(10) Jurisdictional Conflicts
(11) Employment Effects
(12) Social Status

It should be noted that effects (3) through (8) are the same effects previously considered in the performance scoring of solid waste. In this section, however, these effects are considered only with reference to the physical components of waste management systems.

b. Ranking and Rating of Effects

The second step required the determination of relative importance and subsequent weighting factors for each of the identified effects.

The forced decision-making method previously used in the performance scoring procedure development was also used here to rank the effects. However, a larger number of individuals provided ranking for this procedure than for the performance scoring procedure. A total of 20 individuals, both technical and nontechnical, provided separate rankings for the various effects in each subregion.

These rankings of each effect were totaled for each subregion and ratings determined for the 12 effects by setting the highest totaled ranking score equal to 1.0 and rating the other effects in that subregion in proportion to their totaled ranking score.

D. CONCEPTUAL DESIGN OF WASTE MANAGEMENT SYSTEMS FOR THE FRESNO REGION

The objective of this portion of the study was to investigate basic approaches to solid waste control in the Fresno study region and to delineate a number of systems in sufficient detail to permit their evaluation in terms of cost, performance, and ancillary effects. Since it would be possible to enumerate several thousand combinations of potential candidate systems, it was necessary to use sanitary engineering judgment to restrict the analysis to a manageable number of systems representative of significantly different alternatives.

Eighteen systems were postulated for managing municipal and industrial wastes and four methods devised for agricultural wastes. In addition, the methods presently used for handling both categories were delineated.

The 18 systems analyzed for municipal and industrial waste were as follows:

1. Containers - Vehicular Collection - Landfilling
2. Containers - Vehicular Collection - Incineration - Landfill
3. Containers - Vehicular Collection - Processing (product) - Landfill
4. Special Containers - Automated Pickup - Vehicular Collection - Landfilling
5. Special Containers - Automated Pickup - Vehicular Collection - Incineration - Landfill
6. Special Containers - Automated Pickup - Vehicular Collection - Processing (product) - Landfill
7. Source Grinders - Sewers - Process - Landfilling
8. Source Grinders - Sewers - Process - Incineration - Landfill
9. Source Grinders - Sewers - Process - Processing (Product) - Landfill
10. Optimal Grinding (Pneumatics) - Sewers - Process - Landfilling
11. Optimal Grinding (Pneumatics) - Sewers - Process - Incineration - Landfill
12. Optimal Grinding (Pneumatics) - Sewers - Process - Processing (Product) - Landfill

13. Special Containers - Portable Grinder - Sewer - Process - Landfilling
14. Special Containers - Portable Grinder - Sewer - Process - Incineration - Landfill
15. Special Containers - Portable Grinder - Sewer - Process - Processing (product) - Landfill
16. Optimal Pneumatic Aggregation - Vehicle Transport - Landfilling
17. Optimal Pneumatic Aggregation - Vehicle Transport - Incineration - Landfill
18. Optimal Pneumatic Aggregation - Vehicle Transport - Processing (product) - Landfill

The four agricultural systems considered were:

1. Spread on Ground - Plowed in ground
2. Closed Containers - Vehicular Collection - Sanitary Landfill
3. Closed Container - Vehicular Collection - Incineration - Landfill
4. Closed Containers - Vehicular Collection - Processing (product) - Landfill

The above systems and the existing systems were analyzed in sufficient detail to determine their capacities and effects in handling the projected amounts of various wastes expected to be produced in the year 2000.

E. COST AND PERFORMANCE ANALYSIS

1. Performance Scoring

The scoring methodology and procedures described were applied to the above systems maintaining separate scores for the transient and disposal components of each system. As previously explained, the scores for transient and disposal components of any given system cannot be totalled, since transient scores would tend to be overpowered by the greater magnitude of accumulative disposal scores. Using the existing system scores for both transient and disposal components as separate references, it is possible, however, to determine the percent improvement in the reduction of bad effects for each component (transient and disposal) that could be expected by incorporation of the conceptualized systems. The percent improvement for each component for each proposed system was then calculated, with the overall system improvement represented by the average of the improvement of two system components. The basis for averaging the transient and disposal component improvement percentages is the assumption that the transient and disposal activities are equal with regard to their effect on the environment and society. Table II-1 delineates the performance scoring results for each of the systems postulated.

Table II-1

PERFORMANCE IMPROVEMENT AND COSTS

Municipal-Industrial Systems

System	Performance Score		% Perf. Imp.		Net % Perf. Imp.	Cost (Millions)
	Transient	Disposal	Transient	Disposal		
Existing	36,488	3,114,529	0	0	0	26.9
1	15,989	2,247,393	56	28	42	36.2
2	11,401	966,242	69	69	69	54.7
3	10,185	801,684	72	74	73	49.8
4	9,248	2,536,745	75	19	47	45.6
5	4,607	968,077	88	69	78	64.1
6	3,435	874,818	91	72	82	58.8
7	4,214	2,269,967	88	27	58	50.9
8	3,831	1,585,284	90	49	70	67.8
9	2,277	1,153,194	94	63	78	63.6
10	1,605	1,529,790	95	51	73	122.0

Table II-1 (Continued)

PERFORMANCE IMPROVEMENT AND COSTS

Municipal-Industrial Systems

System	Performance Score		% Perf. Imp.		Net % Perf. Imp.	Cost (Millions)
	Transient	Disposal	Transient	Disposal		
11	2,672	1,586,103	93	49	71	141.2
12	527	885,799	98	74	86	138.4
13	5,589	1,529,331	85	51	68	42.3
14	5,371	1,589,985	85	49	67	61.4
15	3,303	1,343,395	91	57	74	58.9
16	6,721	2,247,382	81	28	60	121.1
17	2,086	966,242	94	69	82	139.1
18	902	874,231	97	72	84	136.0
Selected System	2,020	821,033	94	74	84	48.6

Agricultural Systems

System	Performance Score		% Perf. Imp.		Net % Perf. Imp.	Cost (Millions)
	Transient	Disposal	Transient	Disposal		
Existing	152,953	4,640,474	0	0	0	6.7
1	39,319	3,891,988	74	16	45	6.9
2	55,662	3,308,178	64	29	46	16.9
3	45,560	1,211,728	70	74	72	76.3
4	44,908	609,026	71	87	79	49.9
Selected System	36,759	1,647,006	76	65	70	30.0

2. System Costs

Using the cost data for the various unit processes developed in the study, the cost of handling the projected waste quantities for the year 2000 in the manner prescribed by each system was calculated. The estimated costs for each of the scored systems is also shown in Table II-1. All costs indicated are for the year 2000 expressed in 1967 value dollars.

3. Minimum Desirable Performance

Consultation with State and local Fresno administrative officials resulted in the establishment of minimum improvement goals for any proposed system. It was determined that municipal-industrial systems provide at least a 60 percent improvement over the conditions that would exist if the present system could be continued to the year 2000, and that the agricultural control methods result in a minimum of 50 percent environmental effects improvement.

4. System Cost Limitations

The existing system of management, extrapolated to the year 2000, would cost the region about 33.5 million dollars per year. Of this sum, 25.2 million would be required for municipal waste, 1.6 million for industrial, 5.7 million for manures and 1.0 million for crop residue management. All costs indicated above are in terms of 1967 value dollars.

Based on conservative economic projections, the real disposable income of the region's population is expected to increase about 42 percent with attendant increased standard of living. Considering projected higher education levels and increased affluence, the population can be expected to demand, and be willing to pay for, an improved environment. Continuing the existing system to the year 2000 will not only result in no improvement but, as shown, the result will be a gradual but steady degradation of the environment.

In 1967 the estimated regional expenditure for solid waste management was 10.2 million dollars. This sum amounted to 0.93 percent of the regional income. With the projected increase in per capita real disposable income in the year 2000, 42 percent more will be available from each individual without any increase in the percentage of income being expended for this purpose. Unfortunately, the per capita waste generation, especially the municipal portion, is predicted also to increase. This increase almost matches the increase in disposable income in the region and, thus, the 33.5 million dollars projected for existing system cost in the year 2000 is still 0.90 percent of the increased regional income.

Based on the assumption that 60 percent improvement should be worth doubling the income percentage allocated to solid waste management, a proposed maximum system cost for municipal waste management in the year 2000 was set at twice the projected present system costs, or 50.4 million dollars.

The industrial wastes in the year 2000 are estimated to be approximately 9.1 percent of the projected total regional wastes. Projecting the present system requires an expenditure of 1.6 million dollars, or only 4.8 percent of the regional cost to handle 9.1 percent of the projected total regional wastes. To eliminate this inequity requires the application of a 90 percent increase in costs allocated to industrial solid waste management. In addition, the 60 percent environmental effects reduction, similar to the municipal situation, would require an additional 100 percent cost increase. The proposed limit for system costs of industrial solid waste management in the year 2000 was, therefore, set at 1.9 x 2.0 x 1.6 million, or 6.1 million dollars.

Similarly the projected present system costs for handling manures, which make up 39 percent of the region's solid waste load, is 5.7 million dollars, or only 17 percent of the total system costs. To equalize this situation requires an additional 130 percent management cost allocation, while the attainment of a 50 percent environmental improvement will necessitate an additional 100 percent expenditure over and above the equalizing increase. The system cost limit for manures in the year 2000 was, thus, set at 2.3 x 2.0 x 5.7, or 26.2 million dollars.

The limit for management system expenditure for crop residues for the year 2000 was arbitrarily set at 4.0 million dollars. This amount is four times the projected present system costs. The crop residues in the year 2000 will make up 24.4 percent of the regional solid waste; however, the management of these wastes to the same extent as municipal and industrial wastes would require a considerably greater proportional cost. Since the competitive position of this important regional activity must be considered, a lesser environmental effects improvement has been accepted for these wastes, together with a relatively lower cost.

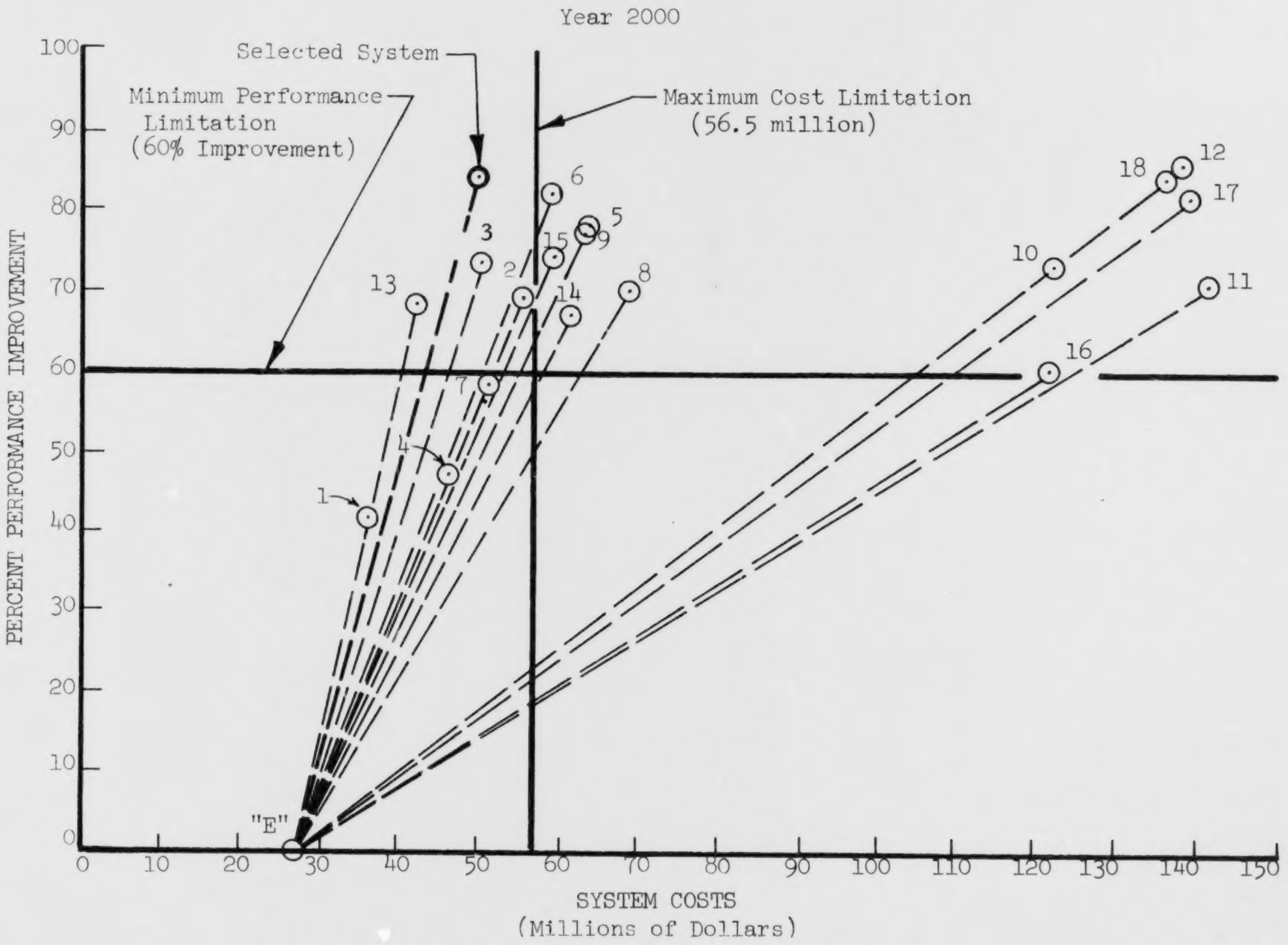
The total solid waste management system limit cost for the year 2000 was determined as follows:

Municipal	50.4 million dollars
Industrial	6.1 million dollars
Manures	26.2 million dollars
Crop Residues	4.0 million dollars
Total	86.7 million dollars

The cost limit for the municipal-industrial system is 56.5 million dollars and that for the agricultural system, including manures, is 30.2 million dollars.

F. SELECTED SYSTEM FOR THE FRESNO REGION

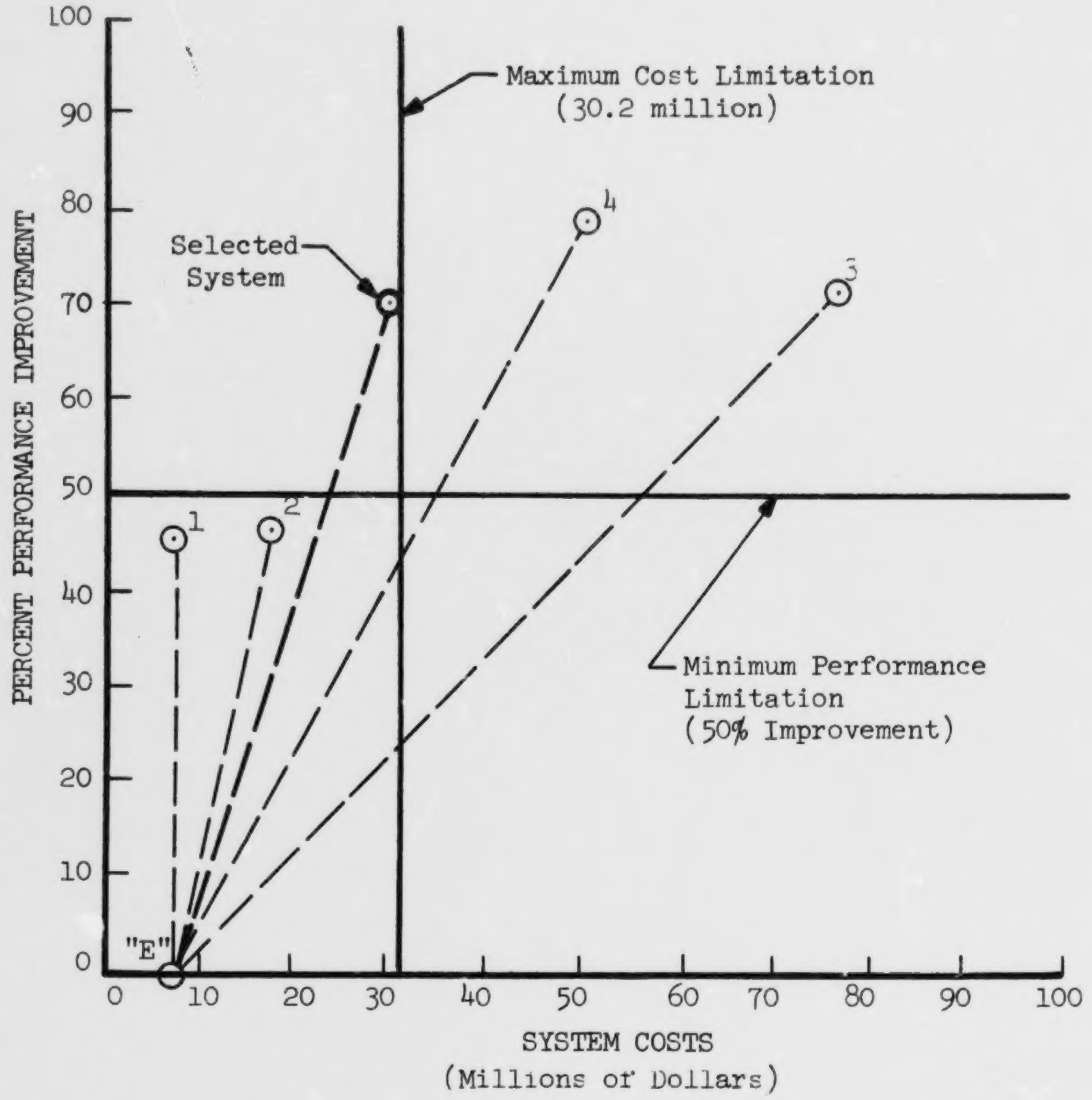
The cost-benefit analysis, shown on Figure II-3, indicated that only municipal-industrial systems No. 2, 3, and 13 satisfied the imposed technical-economical limitations. Considering the assumptions made in arriving at the limits it would be unreasonable not to also consider systems 6, 7, and 15. Figure II-4 showed that none of the postulated agricultural systems met the minimum requirements. Since the individual postulated systems were developed on the basis of handling essentially all wastes by the methods shown with minimal consideration given to legal, political, sociological, and practical constraints, it became apparent that additional analysis was required.



Note: 1. Pt. "E" represents existing system.
2. Slope from "E" to system designation represents % improvement per million dollars expended.

Figure II-3. Cost-Benefit Analysis Municipal-Industrial Systems

Year 2000



Note: 1. Pt. "E" represents existing system.
2. Slope from "E" to system designation represents % improvement per million dollars expended.

Figure II-4. Cost-Benefit Analysis Agricultural Systems

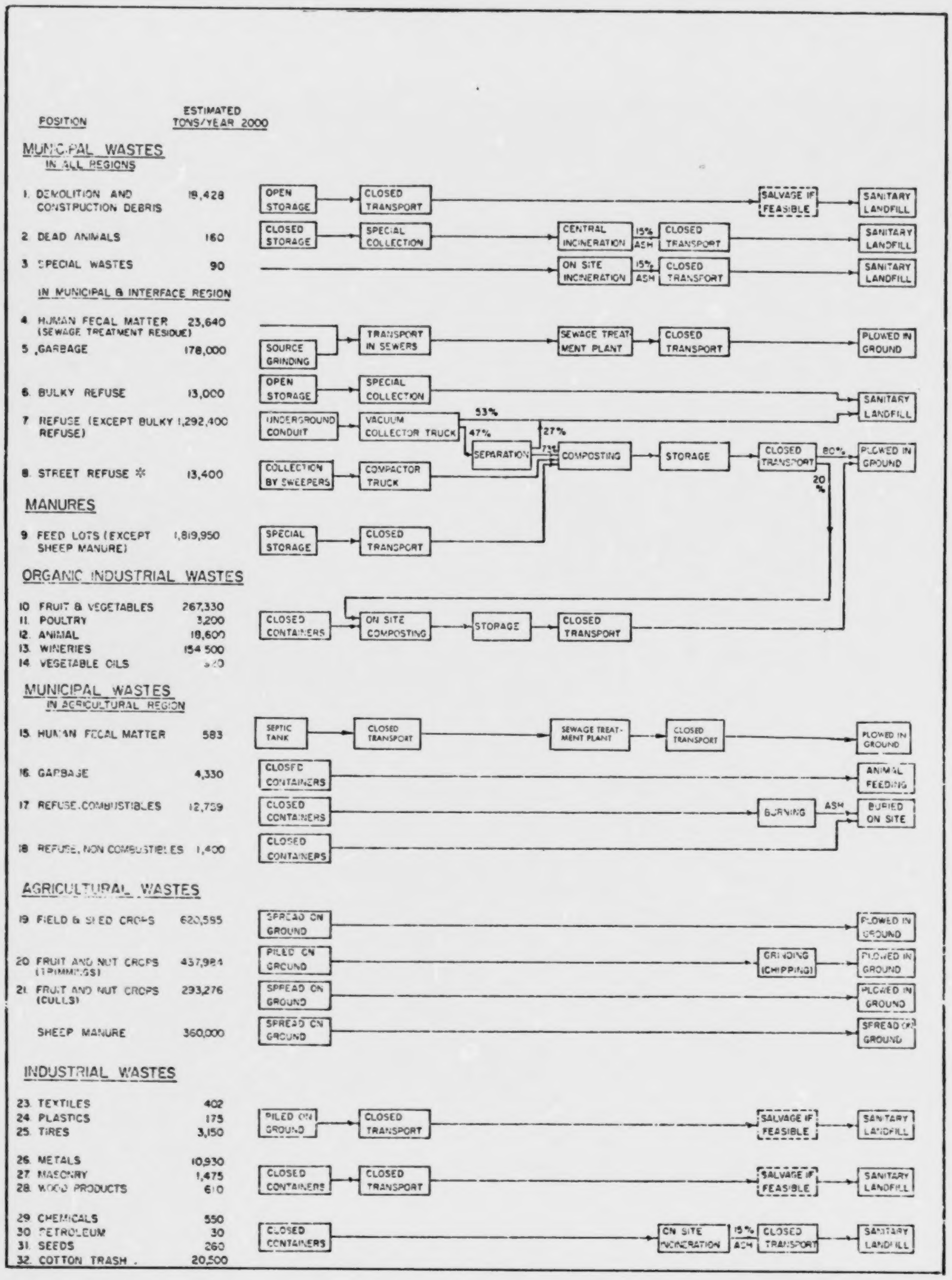
Consideration of the individual quantities of wastes indicated that three categories of solid wastes in the Fresno region constituted almost two-thirds of the total amount generated. These are organic municipal refuse, organic industrial wastes and animal manures. Cost-benefit ratios for all technically feasible methods of handling, both transient and disposal, were therefore determined for each of these three categories to facilitate application of nontechnical constraints. The results of this analysis, with consideration given to all parameters, indicated a much greater variation in methods of handling different categories of wastes would be required than originally postulated.

Sanitary engineering judgment, along with legal, political, and administrative decisions, are required to make any final system selection. Systems analysis furnishes an additional tool with which to assist decision makers; it does not make decisions. Even in the event that sophistication of computer applications provides perfection of the technical-economic selection process, the legal, political, and administrative decisions will still be required.

The proposed solid waste management system for the Fresno region, as shown in Figure II-5, is a combination of the various transient and disposal systems. The system handles the different waste categories in a variety of ways, with the most intensive and advanced treatment reserved for the three above mentioned types of waste. The proposed system allows for an orderly transition over a period of time from the existing system to that being proposed for the major affected waste types. At the same time, the methods of handling waste categories of relatively little consequence, or those subsystems that are presently efficient, are little changed in the proposed system.

The costs of the proposed system in the year 2000 are estimated to be:

Municipal	42.7 million dollars
Industrial	5.9 million dollars


POSITION
ESTIMATED TONS/YEAR 2000
MUNICIPAL WASTES
IN ALL REGIONS
1. DEMOLITION AND CONSTRUCTION DEBRIS 18,428
OPEN STORAGE
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
2 DEAD ANIMALS 160
CLOSED STORAGE
SPECIAL COLLECTION
CENTRAL INCINERATION
15% ASH
CLOSED TRANSPORT
SANITARY LANDFILL
3 SPECIAL WASTES 90
ON SITE INCINERATION
15% ASH
CLOSED TRANSPORT
SANITARY LANDFILL
IN MUNICIPAL & INTERFACE REGION
4 HUMAN FECAL MATTER (SEWAGE TREATMENT RESIDUE) 23,640
5 GARBAGE 178,000
SOURCE GRINDING
TRANSPORT IN SEWERS
SEWAGE TREATMENT PLANT
CLOSED TRANSPORT
PLOWED IN GROUND
6 BULKY REFUSE 13,000
OPEN STORAGE
SPECIAL COLLECTION
SANITARY LANDFILL
7 REFUSE (EXCEPT BULKY REFUSE) 1,292,400
UNDERGROUND CONDUIT
VACUUM COLLECTOR TRUCK
53%
47%
SEPARATION
27%
73%
COMPOSTING
STORAGE
CLOSED TRANSPORT
80%
20 %
PLOWED IN GROUND
8 STREET REFUSE * 13,400
COLLECTION BY SWEEPERS
COMPACTOR TRUCK
MANURES
9 FEED LOTS (EXCEPT SHEEP MANURE) 1,819,950
SPECIAL STORAGE
CLOSED TRANSPORT
ORGANIC INDUSTRIAL WASTES
10 FRUIT & VEGETABLES 267,330
11. POULTRY 3,200
12. ANIMAL 18,600
13. WINERIES 154 500
14 VEGETABLE OILS
CLOSED CONTAINERS
ON SITE COMPOSTING
STORAGE
CLOSED TRANSPORT
MUNICIPAL WASTES
IN AGRICULTURAL REGION
15. HUMAN FECAL MATTER 583
SEPTIC TANK
CLOSED TRANSPORT
SEWAGE TREATMENT PLANT
CLOSED TRANSPORT
PLOWED IN GROUND
16. GARBAGE 4,330
CLOSED CONTAINERS
ANIMAL FEEDING
17 REFUSE. COMBUSTIBLES 12,759
CLOSED CONTAINERS
BURNING
ASH
BURIED ON SITE
18 REFUSE, NON COMBUSTIBLES 1,400
CLOSED CONTAINERS
AGRICULTURAL WASTES
19 FIELD & SEED CROPS 620,585
SPREAD ON GROUND
PLOWED IN GROUND
20 FRUIT AND NUT CROPS (TRIMMINGS) 437,984
PILED ON GROUND
GRINDING (CHIPPING)
PLOWED IN GROUND
21 FRUIT AND NUT CROPS (CULLS) 293,276
SPREAD ON GROUND
PLOWED IN GROUND
SHEEP MANURE 360,000
SPREAD ON GROUND
SPREAD ON GROUND
INDUSTRIAL WASTES
23. TEXTILES 402
24. PLASTICS 175
25. TIRES 3,150
PILED ON GROUND
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
26. METALS 10,930
27. MASONRY 1,475
28. WOOD PRODUCTS 610
CLOSED CONTAINERS
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
29. CHEMICALS 550
30 PETROLEUM 30
31. SEEDS 260
32. COTTON TRASH 20,500
CLOSED CONTAINERS
ON SITE INCINERATION
15% ASH
CLOSED TRANSPORT
SANITARY LANDFILL

*Leaves (only) to composting; dirt and sand to landfill

Figure II-5. Proposed Solid Waste Management System (Fresno Region)

Manures	26.5 million dollars
Crop Residues	3.5 million dollars
Total	78.6 million dollars (1967 value dollars)

These system costs all fall within the pre-set expenditure limits.

The effectiveness of the proposed system is indicated by the calculated 84 percent improvement of environmental effects for the municipal-industrial portion and an improvement of 70 percent for the agricultural portion. In addition, the proposed system ancillary effect score of 17.24 is considerably lower than that of any of the previously postulated systems falling within the cost benefit limits. These improvements, well above the program goals and within reasonable expenditures, are the result of a successful application of the postulated procedures.

G. APPLICATION TO OTHER REGIONS

The application of the study methodologies to an area similar to the Fresno region in geological and meteorological conditions, population distribution and growth pattern, and agricultural, industrial and commercial mix, would essentially entail the procedures previously outlined. However, most practical applications would require adjustments to the methodology because of the peculiarities of each region to be evaluated.

The following procedures, in general, will be necessary for the successful application of the study procedures for the analysis of solid waste problems in other regions.

It will, first, be necessary to establish the conditions under which any system proposed will be required to operate in the proposed region during the evaluation period. This will entail the gathering of data on regional geology, climate, population, economy and governmental operation, in addition to the determination of the existing and projected kinds and quantities of solid waste to be managed.

Next, the scoring procedure developed in the Fresno study will need revision to account for the different scale in which certain bad effects may be viewed in the region in question. The basic bad effects scores without the application of the influence coefficient, can be used for all wastes common to those in Fresno. For different wastes basic bad effects scores must be developed. The procedures developed in this study could then be used to determine influence coefficients for the region in question which would very likely be different from those developed for Fresno. With the basic bad effects and the new influence coefficients, the weighted bad effects scores could be calculated and proposed systems scored.

In determining proposed system costs for a region other than the Fresno region, consideration must be given to the local physical and economic conditions. The costs of local labor, material, construction and land must be evaluated, as well as the local topography and availability of suitable sites for proposed system processes.

The ancillary effects scores of another region will require the application of the same techniques used to arrive at the scores in the Fresno region. However, more, less, or even different effects may be important in other regions.

With performance scores, costs, and ancillary effects determined, system effectiveness can be compared and the optimum system selected.

H. COMMUNITY ACCOMPLISHMENTS

Establishment of the Council of Fresno Governments, although not directly related to the performance of this study, can be partially attributed to the ongoing effort. The formation of this Council, although political and not administrative in nature, provides a forum to review the need for co-operative community and regional endeavors, and makes for a better understanding of the interrelationships of local action on the total community.

From this understanding, programs and activities that are beneficial to the majority while protecting the minority are most likely to be attained.

During the performance of this study, the participants maintained continuous contact with local city and county officials and administrators whose cooperation is highly commended. This direct contact provided a free interchange of ideas and thoughts, making possible a much clearer understanding by the participants of local administrative problems. The establishment of this relationship provided the information needed for the application of systems analysis to the socio-economic problem under consideration.

The city and county governments, during the eighteen months of this study, have instituted many improvements in the existing solid waste management system. Several of these steps were taken as a direct result of the June 1967 Interim Report; others developed from direct consultation during the study, or from independent action. Additional important accomplishments are summarized in the following paragraphs.

1. City of Fresno

a. An ordinance was passed making twice-a-week collection of garbage mandatory, with a few exceptions. This procedure will effectively interrupt the normal fly-breeding cycle.

b. Partially as a result of the above ordinance and also as part of a replacement program, the city has purchased additional vehicular equipment.

c. Schedules and routing have been revised to meet the requirements imposed by twice-a-week collection and to improve the operating efficiency.

d. Collection fees have been increased to meet the higher costs of labor and equipment.

2. County of Fresno

a. The County has prohibited open burning at dump sites and has also stopped open burning by certain specified industries.

b. Mandatory once-a-week collection has been imposed on suburban residents with lot sizes of 36,000 square feet or less, where such service is available.

c. The County has acquired two additional landfill sites and is actively seeking others.

d. Conditional use permits have been made a requirement for solid waste disposal operations.

3. City and County

A cooperative program has been developed to delineate specific off-street sewer access for unloading septic tank pumpers into the sewerage system. Wash-down facilities are being provided at each location The operation will be based on a fee system for the private operators of septic tank pumpers.

4. Private Operators

a. Nine separate scavenging operators have merged to create a single large collection and disposal company. Operations by this one large firm will provide greater efficiency in routing and service to that portion of the community not served by municipal agencies.

b. A transfer station has been built on the site of a former landfill to serve the private operation described above.

5. Industry

The automobile dismantlers are forming an association to seek ways of satisfying the county ban on open burning of junk vehicles. Various incineration devices and other means of scrapping automobiles are being investigated by this newly formed organization.

I. RECOMMENDATIONS

1. System Implementation

The first action required to develop the proposed system concept is the assignment of some form of regional control. Such an agency (County or special district) could have powers for supplementing and complimenting the activities of pertinent local agencies in all aspects of solid waste handling from collection to final disposal, with the extent of local participation determined by local option. The regional agency would, therefore, have responsibility for overall conduct of the regional system, including direct responsibility for performing all necessary functions not performed by local agencies and for necessary coordination of all participants. The composition of boards of direction of such an agency would include appropriate representation from all cognizant local agencies. If Fresno County assumed the responsibility, the Board of Supervisors would represent such leadership.

One important function of the regional approach would be management of final disposal of the compost to be produced by the recommended plan. As noted in the detailed report, composting as recommended in this report, differs from composting schemes elsewhere in that the composting program is based not solely on the value of the compost for agricultural purpose (as is usually the case) but also on long-term environmental values, considered to be of equal magnitude of importance. It is believed that, on this basis, a positive program for planned disposal of compost, with the responsibility for initiative and management on the regional agency rather than on the agricultural interests, can be successfully achieved in a unique manner not previously accomplished in this country. In other words, the use of the land for compost disposal should be managed by the regional agency, including agricultural interests but with the agricultural interests subordinated to the primary function of disposal — an example of this method of operating is the disposal/farming activity successfully carried on for the past two decades in Ontario, California by the Sunkist Orange Products for disposal of citrus by-products wastes.

a. Immediate Action

(1) Recommend to local authorities the passage of ordinances to restrict the storage of most municipal and industrial solid wastes to closed containers. Excluded from this restriction would be demolition and construction wastes, bulky refuse, textile wastes, plastics, and tires.

(2) Recommend to local authorities the passage of ordinances to eliminate open transport of all municipal-industrial solid wastes. This does not mean that open body trucks could not be used; only that tarpaulins or similar covers would be required.

(3) Phase out all open dumping operations in favor of properly operated sanitary land fills.

(4) Recommend that local authorities, acting via the Air Pollution Control District, prohibit open burning of all municipal, industrial, and agricultural wastes.

b. Medium to Long-Range Action

(1) Adopt and enforce state standards for sanitary landfilling site operations.

(2) Determine precise requirements of landfill area for the thirty year period and acquire necessary sites. This program must be coordinated with cognizant land use planning agencies.

(3) Establish through the Air Pollution Control District operational (air pollution) requirements for on-site industrial incinerators.

(4) Construct a pilot-scale operation and perform a test program for the recommended collection system.

(5) Obtain a demonstration grant to construct, test, and improve the National Canners Association's proven composting process for cannery wastes (full-scale).

(6) Obtain a demonstration grant to build and test a pilot-scale composting operation for the processing of manures and municipal refuse.

(7) Perform studies on manure storage and collection at dairies, cattle feed lots, and poultry farms.

(8) Establish a program for the development of a compost market in the study region. The use of compost in parks, municipal golf courses, and certain areas of highway rights-of-way would provide a convincing demonstration of its benefits.

(9) Determine the technical and economic feasibility of providing collection of certain crop residues during the harvesting process. The possibility of utilizing this material, either as potential animal feed, or in the composting process, should be thoroughly explored to prevent temporary land degradation from internment or air pollution from burning. The mechanical harvesting of certain crops, with resulting concentrations of residues in windrows or piles, will lead to possible solutions that are currently too expensive because of added costs for picking up and concentrating the residues. The harvesting of tomatoes by mechanical means is an example of this change in technology.

2. Basic and Applied Research

The Solid Waste Disposal Act of 1965, resulting in the formation of what is now known as the Solid Waste Program, has funded many research programs encompassing virtually all facets of solid waste activities. Summaries of research, training, and demonstration grants are available from the U.S. Department of Health, Education, and Welfare, Public Health Service.

There is no need to repeat here what work has been done or what is currently being done but, rather, to point out those specific areas of research requiring additional effort. In general, the Federal Government's purpose, in this respect, is to assist local communities in the prevention of pollution by solid wastes, with particular emphasis on conservation.

The results of this study have brought into focus certain fields of endeavor in solid waste research that appear to be worthy of further development. These programs are recommended in addition to those mentioned as part of the system implementation.

a. Computer Program

The Fresno study has devised a method of measuring the environmental effects caused by handling solid wastes in a variety of ways. The ancillary effects of these "systems" have also been determined. The synthesized systems can be scored, using these techniques, by the minimal computer program developed for this purpose. This program does not, however, provide the overall sophistication required to select the optimum from a large array of candidate concepts. The development of such a computer program, utilizing available mathematical techniques would be of great value in perfecting the technical-economic optimizing technique.

b. Disposal to Sewerage Systems

The cost-benefit analysis of various systems indicated that sewer collection and sewage treatement of certain wastes would probably provide one of the better total methods. Some other technical and nontechnical constraints prevent this method from being a part of the recommended system, except for garbage. Some work has been done in the past with regard to grinding of solid wastes and their disposal to the sewerage system but the results have been inconclusive. It is recommended that basic research be conducted toward determining design and cost factors involved in grinding (central and source) solid wastes, the effects on sewage flow, and the ultimate effects on sewage treatment plant facilities.

c. Pneumatic Collection Systems

Pneumatic collection systems for high-rise buildings and hospitals are currently in existence. They can also be utilized for commercial or institutional operations. These systems are relatively high in initial cost but can be amortized over several years on the basis of labor savings. The development and utilization of pneumatic collection systems for single family, low density areas would be basically contingent on the demand by society for ultimate environmental improvement, convenience, and the willingness to pay.

It is recommended that applied research be conducted to modify existing pneumatic systems for low density areas with improved sanitation, esthetics, and lowered costs as the prime objectives.

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III. PROBLEMS OF SOLID WASTES

A. OBJECTIVE

The principal objective of this discussion is to identify environmental pollution problems that can be attributed to solid wastes in any condition. This is done with the aim of establishing the relationship between solid wastes and direct or indirect bad effects to allow measurement of the effectiveness of postulated systems for reducing such problems.

The secondary objective is to determine and identify the "customers" for solid waste management, i.e., all governmental groups and agencies acting as representatives of society in such matters.

B. SOLID WASTE DEFINITION, IDENTIFICATION, AND CONDITIONS

1. Definition

There is no precise definition of solid wastes, either in the literature or among people working in the field. Wastes can be defined as the useless, unwanted, or discarded materials resulting from normal activities. This definition, however, includes solids, liquids, and gases.

The American Public Works Association (APWA) (1) categorizes solid wastes as refuse, including "... semi-liquid or wet wastes with insufficient moisture and other liquid contents to be free-flowing."

The physical state of various wastes may undergo change during treatment or transport. The definition problem involves the inclusion of what might at one stage be classified as liquid waste, whether the solids are in suspension or solution, and at another stage as the combustion and evaporation products of wastes discharged into the air.

Consideration must also be given to by-products of normal activities that potentially have value and may be returned to the useful economic cycle. Examples include animal manures, which are or could be used as fertilizers; junked automobiles, from which parts are or may be cannibalized and hulls possibly returned to the smelters; and automobile tires, of which small portions currently return as doormats or shoe soles. These are but a few of the possibilities. Other wastes (tin cans, glass, paper, cardboard, etc.) are salvaged depending on market conditions. The important question is: When are these by-products solid waste and when are they still a part of the industrial cycle?

Because these products can produce what are later referred to as the "bad effects" of solid wastes - during their storage, collection, transport, processing and disposal - they influence, to a considerable degree, consideration of any "waste" management system. They must, therefore, be included with waste materials for which there is little, if any, potential economic value. Such materials will, therefore, be considered, even if only temporarily, within a normal definition of solid wastes.

On the basis of these considerations, the following definition is offered: Solid waste is that normally solid material arising from animal or human life and activities and discarded permanently, or temporarily, as waste. It also includes deposited waste particulates temporarily suspended in air or water.

2. Solid Waste Identification

Table III-1 provides a comprehensive list of all the solid wastes identified as existing in the study region. It does not include all solid wastes, but only those occurring in the region and in sufficient quantities to create a problem. The sources are indicated below.

a. Municipal

The basic information on the composition and source of municipal solid wastes was derived from Municipal Refuse Disposal, 1966 edition, an APWA publication. The Fresno City ordinance requires separation of the categories of "residential rubbish" and "mixed garbage" but it appears there is limited enforcement of their separation.

b. Agricultural

Information on agricultural solid wastes was obtained from the U.S. Department of Agriculture (USDA) "Agricultural Crop Reports" of the last several years for Fresno County. References 2, 3, and 4 provided information on the composition of agricultural waste.

c. Industrial

Types of industrial solid wastes were identified on the basis of the Fresno County Chamber of Commerce report and listing of industries for 1965. References 5 to 10 were used to establish the composition of wastes for the various industries.

The waste compositions were further verified by personal interviews with managers and operators of various industries for all categories of waste.

3. Conditions of Solid Wastes

The conditions of solid wastes, defined below, were established to represent all known states and conditions in which solid wastes exist. As an example, a system utilizing pneumatic tubes for transport is conceivable and obviously falls within the condition of "closed" transport, even though it might be considered an advanced concept. Several known methods of solid-waste "processing" do not appear as such in the list of conditions, but it is believed that all will fit into one or more of the universal conditions identified.

The conditions,which required additional specification to be meaningful and to avoid different interpretations,are discussed briefly below.

a. Unmanaged

In this condition, a solid waste would be allowed to remain uncollected at the point of generation. It is postulated to provide a base for performance scoring procedures developed later. The problems created by allowing such accumulations are obvious. The literature is replete with evidence of rampaging epidemics directly or indirectly connected with failure to manage solid wastes.

b. Spread on Ground

This condition is defined as sufficiently thin spreading to permit rapid drying. The method has been used for manures and other organic wastes. S.A. Hart (11) indicated its usefulness in drying manures for later use and also pointed out the possibility of fly production with thick spreading and the possibilities of offensive odors without proper control. Because the present study is not limited to flies and odor, attempts were made to determine how such a condition for any waste would contribute to all bad effects, as has been done for all conditions.

c. Piled on Ground

This condition of storage, both temporary and long-term, is being used to a large extent for many wastes. It requires no special definition, and the possible effects of organic wastes in giving rise to odors and providing harborage for flies and insects can easily be recognized. Other substances can cause water, land, and air pollution, as well as possible toxicity and safety hazards; most solid wastes handled this way can be esthetically offensive.

d. Piled on Slabs

Identical to "piled on ground" with the possible exception that it may minimize the possibility of water pollution.

e. Containers, Open and Closed

Containers of every size, type, and description are being used to store solid wastes. To obtain ratings for solid wastes in this condition, it was considered that closed containers are subject to less moisture loss by evaporation than open containers and are also subject to possible heat of fermentation from organic wastes. Closed containers were also defined as being rodent-tight but not insect-tight. Containers, open and closed, were defined to include pick-up once a week with normal cleaning.

f. Transport, Open and Closed

This condition has the same specification as "containers, open and closed," with the exception of the pick-up criterion.

g. Grinding

Pulverization is generally considered a stage in the overall handling of solid wastes. A. G. Davies (12) states, "...there are advantages to be gained in the crushing of refuse to a reduced bulk of about fifty percent..." - i.e., less space is required for both transport and ultimate disposal. He also said such processing provides an "...innocuous material unlikely to create nuisance." The last statement is open to question; less of a problem, perhaps, but not universally innocuous. Research has revealed that the cellulose portion of refuse might present little problem, and added potential for the production of methane gas, if shredded and introduced into existing sewer systems (13). For the performance interviews, grinding was defined as pulverizing to 1/4 to 1/2-inch size, except for abandoned vehicles which are ground to approximately 1-1/2 by 6-inch strips or sometimes battered into balls approximately 3 to 6 inches in diameter.

h. Spray Irrigation

The processes of evaporation, transpiration, and filtration into the ground are involved in this condition. A small amount of mineral matter is used by vegetation, and only water is evaporated and transpired. This, in turn, leaves a higher concentration of solids in the soil than in the original waste water (14). The process may be a follow-on to grinding and can be considered as a disposal method. Spray irrigation or disposal has been used for food processing, slaughterhouse, and chemical wastes, but adverse effects have been reported.

i. Incineration

This category is defined as normal municipal, apartment house, industrial, and commercial incineration. Golueke and Gotaas (15) stated:

"Incineration has often been considered the most modern method of refuse disposal. At best, this method, in addition to being expensive, increases atmospheric pollution since large tonnages of material are converted to gases and particulate matter and emitted to the atmosphere. At worst, it results in smoke, unpleasant odors, and disagreeable air pollution. In addition, the organic humus and plant nutrients in refuse are destroyed by incineration."

A report on solid wastes prepared for the National Commission on Technology, Automation and Economic Progress in February 1966 (13) added that insufficient work has been done to permit the determination and control of organic gaseous products from the incineration of solid wastes. Included in these effluents are organic compounds of aldehydes, oxides of nitrogen, organic acids and esters, phenols, and polynuclear hydrocarbons. Abnormal physiological responses can result from exposure to these compounds, and some have proved to be carcinogenic. There can be no doubt that municipal incineration, as well as backyard burning, contributes a significant burden to the atmosphere. The report further stated, "No current municipal incinerators are considered acceptable where climatological conditions create severe smog concentrations." With regard to backyard burning, the report indicated that the general inadequacy of present incinerators results in further contribution to air pollution.

j. Open burning

Incineration provides at least some measure of control and usually eliminates problems of rodent, fly, or insect harborage. Open burning, because of its generally uncontrolled and inefficient burning capabilities, not only fails to match incineration with regard to total burning, emission to the atmosphere of pollutants, and reduction of quantity, but also does not necessarily eliminate animal and insect disease vectors and can be considered a definite safety hazard.

Backyard open burning, teepee burners, industrial-waste open burning, agricultural-crop-residue burning, and even burning at dumps have been permitted in the study region. Under certain adverse climatological conditions, the smoke problem becomes obvious. The burning of agricultural wastes from grain fields and orchards has long been considered a practical method for their disposal. E. F. Darley, et. al. (16) have reported that the emissions from such agricultural burning are much less, in pounds of effluent per ton of material burned, than those from the automobile exhaust. The results of this study indicate there are more practical methods for disposal of these wastes.

k. Composting

Composting is defined here as limited to properly operated, mechanical methods of solid waste reduction. A comprehensive review of the literature and laboratory and field-scale investigations of composting was conducted by the University of California (17). One conclusion reached was as follows: "Intensive farming exhausts the organic constituents of the soil unless humus is added. Humus such as might be obtained from the composting of municipal refuse benefits the soil by: (a) improving soil structure, (b) increasing moisture-holding capacity, (c) preventing leaching of soluble inorganic nitrogen, (d) making phosphorus more readily available to growing plants, (e) increasing buffer capacity of the soil, (f) adding nutrients, especially nitrogen, phosphorus, and potassium, as well as essential trace elements."

According to Golueke and Gotaas (15), the composting of garbage, refuse, sewage sludge, and other organic wastes not only reclaims some materials for use as soil conditioners, but reduces fly, rodent, odor, and other sanitary problems. The operation must be carefully controlled or, as Gotaas (18) notes: "If adequate control measures are not practiced, particularly when composting manure and faeces, the compost depot will be infested with extremely large numbers of flies, and a health hazard almost as serious as that caused by open, uncontrolled garbage dumps will be created."

l. Lagooning

Lagooning is limited here to properly designed and operated units. Lagoons, or "stabilization ponds," may be designed on a volumetric basis or on a surface-area basis using population equivalents. They are particularly adaptable for farm use and many industrial wastes. Lagoon operations should avoid floating material, overloading, and intermittent loading, and weeds should be kept mowed at the edge of the lagoon to avoid mosquito and rodent populations (19). The use of lagoons is limited where (1) land is not available, (2) land is too porous, (3) underground water might be contaminated, (4) excessive influent might cause overflow to contaminate surface water, or (5) land is too costly.

m. Landfill

This is defined as the properly engineered burial of solid wastes, i.e., burial of all refuse within 24 hours, and with a compacted earth cover sufficiently thick to prevent insect, rodent, and other vector problems. Sanitary landfills can become a desirable asset to a community if, when completed, the site can be used for parks, recreational purposes, or light construction. Underground fires and dust nuisances usually result from careless operations and can be minimized. The potential groundwater contamination from leachate and decomposition gases must be considered as well as differential settleme Investigations (13) have shown that little or no impairment of groundwater occurs from leaching if the fill is located away from intercepting groundwater. Should the groundwater intercept the refuse, gross pollution can occur. Gas movements can also produce pollution as well as create safety hazards. As McLemore (20) stated, "...sanitary fills depress the surrounding real estate, causing slum areas and undesirable development thereby causing a loss in tax revenue." A review of assessed values of property in the vicinity of landfills in the study region tends to substantiate McLemore's claim, except that these generally are "dumps" and not sanitary landfills. Landfills in abandoned rock quarries, ravines, and other areas requiring reclamation can restore rather than reduce land values. The record in Los Angeles County proves that sanitary landfills, operated in accordance with sound engineering principles, can handle solid wastes while enhancing adjacent real-property values.

Where the water table is close to the surface and the groundwater is potable, such practice would definitely appear undesirable.

n. Buried

This category is defined as having only a loose, limited depth of cover. Such a process has all the problem features of the sanitary landfill with none of the benefits.

o. Open Dump

The open dump is still common in this country and widely used in the study region. It contributes to all the bad effects of solid wastes. The use of open dumps permits water, land, and air pollution and the various effects of disease-vector production, odors, and unsightliness. Open dumps can be eliminated with minimal pressure on the part of the proper authorities, preferably before pressure is applied by irate citizens.

p. Plowed into Ground

This category is defined as spread thinly and plowed within a reasonable period, with only partial burial. The method is widely practiced in the agricultural region, with divergent results. The first result with most crop residues is nitrogen depletion of the soil, in some instances so severe that commercial fertilizers must be applied to restore the balance. Should the crop be infected with harmful pathogens, this practice has a tendency to build up soil reservoirs of pathogens, resulting in increased damage to subsequent crops. Crop sequencing can sometimes resolve the infection problem if the follow-on crop is not susceptible to the pathogens harmful to the preceding crop.

q. Pit Disposal

This is defined as deposition in a hole in the ground and covering with a loose-fitting lid. It is included as a method of final disposal because it is used by poultry growers in the study region.

C. ADVERSE EFFECTS OF SOLID WASTES

The problem areas related to solid wastes actually include economic, engineering, legal-jurisdictional, and social-psychological aspects, in addition to environmental health, the concern in this discussion.

The search to identify the bad effects of solid wastes was related to the three major categories of land, water, and air pollution but, to properly assess the total effects, attention was also devoted to the direct and indirect effects of human disease, animal disease, flies, rodents, insects, plant disease and crop damage, safety hazards, toxicity, and the esthetic factors of odor and unsightliness. The difficulty lies not in identification of these factors as possible bad effects resulting from solid waste mishandling but rather in separating the effects. It can be readily seen, for example, that all the bad effects listed can, if allowed, result in some form of human disease. It is impossible to think completely in terms of solid wastes to the exclusion of liquid and gaseous wastes, because the method of handling can produce liquid and gaseous wastes, with resultant bad effects. Flies, rodents, insects, and toxicity can create plant disease and crop damage which, in turn, can result in animal disease.

Rogus (21) states: "The adverse effects on health caused by improper handling (of solid wastes) have been well established. Extensive research and many cases on record show that diseases, rodent and insect propagation, fire hazards, and air and water pollution, can be traced in many instances to improper management of solid wastes."

Anderson (22) reminds us, "... disposal of solid wastes is fundamentally a health problem." The World Health Organization (WHO) defines health as "...a state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity." Environmental health, WHO continues, can be defined as "the control of all those factors in man's physical environment which exercise or may exercise a deleterious effect on his physical, mental, or social well-being."

Assessment of the total environmental health problem as related to the handling of solid wastes is, therefore, the problem at hand. This task is difficult because there are few, if any, directions, guides, data, or facts.

As Dunsmore (23) quotes Burney, the bad effects are "...so interwoven and mutually reinforcing, that they can be dealt with most effectively if they are considered as parts of an interrelated whole, the total environment of modern man." Stead (24) writes, "...we must invent decision-making machinery that will take into account all the factors which affect the system that it is attempting to manage."

The decision-making machinery developed in this report (performance scoring procedure) provides a method for evaluating the integrated environmental effects based on an initial determination of the individual and separate effects of solid wastes. An explanation of the performing-scoring procedure is presented in Section IV. This procedure was developed, using the limited data available, with considerable reliance on value judgments of various experts as well as expertise in systems analysis.

Investigations of the study region, discussions with experts from the California Bureau of Vector Control, Department of Public Health, and a review of the literature all led to the same conclusion. Domestic flies breed exclusively in organic, readily putrescible solid wastes. They often breed throughout the year and are only somewhat inhibited by cold weather. They have a strong tendency to follow windborne odors and will disperse as far as 20 miles due to population pressures. Flies have been proven to be vectors for as many as 30 diseases and are, in addition, a nuisance to society. They provide, then, a near perfect index of the control of organic solid wastes: no flies, no organic solid waste problem.

A comprehensive survey of the existing literature was conducted to ascertain the relationship between solid wastes and the various environmental effects. The survey was published as a part of the Interim Report for this study in June 1967. The survey appears in this final report as Appendix A, Volume II.

D. CUSTOMERS OF SOLID WASTES

"Customers" is used here to mean all groups, agencies, and agency representatives who, acting in the interests of society, are adversely affected by inadequate waste management practices. They are extremely important in this assessment and identification of solid waste problems, and are listed in Table III-2, which provides names, addresses, and telephone numbers as of the date of this report. Table III-3 lists all "customers" selected for interviews on the effects of solid wastes and their rating.

Following determination of the solid wastes in the study region, development of a universal list of conditions for them, and a description or delineation of their bad effects, it became evident that a rational performance-scoring procedure required a numerical value for each Fresno region waste product to represent its relative contribution to each bad effect under each waste condition. The literature provides only sparse data of this type; consequently, experienced practitioners in the sanitary engineering and environmental sciences fields (the "customers") were interviewed to establish the ratings described in detail in Section IV. This value-judgment approach, used in an ordered manner, does not provide measured and quantified data, but appears the best that can be taken in view of the many years of research required before such information can be experimentally generated.

Selected State and local Fresno experts in public health, waste management, vector control, water resources, and agriculture were interviewed. They were asked to list all wastes that would contribute to any of the bad effects under any of the listed conditions. They were then asked to score the relative contribution of unit quantities of each of these wastes to the bad effect for each condition.

These experts were requested to score on a scale of 0 to 5 for each condition, with 5 representing the most serious contributor under each condition and so on down to 0 for those contributing negligibly or not at all. The difference in the degree to which the wastes generate bad effects, depending on the condition of the waste, was recognized, and the experts were asked to judge these relative degrees. Their averaged answers and the resultant scores are shown in Section IV

The information obtained provides the foundation for the performance-scoring procedure. The investigators in this study are indebted to the listed engineers and scientists for their extensive knowledge and their willing cooperation and assistance.

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Table III-1

SOLID WASTES

Type	Composition	Source
	Municipal	
1. Garbage	Food wastes from preparation, handling, storage, and sale of food, and dead animals (10 lb)	Households, hotels, restaurants, institutions, stores, markets
2. Residential rubbish (as used in the Fresno area)	Paper, cardboard, yard trimmings	Households, hotels, restaurants, institutions, stores, markets, factories, offices, theaters, industries, parks, playgrounds, parking lots, etc.
3. Mixed garbage (as used in the Fresno area)	Garbage and residential rubbish, metals, dirt, glass, crockery, ashes, metal furniture, minerals, wood, rags, etc.	
4. Street refuse	Sweepings, leaves, litter, animal droppings	Streets, sidewalks, alleys, highways, roads, vacant lots
5. Dead animals	Cats, dogs, horses, cows, etc. (over 10 lb)	
6. Abandoned vehicles	Unwanted cars, trucks, tractors, bicycles, and motorcycles left on public property	
7. Demolition wastes	Lumber, roofing paper, wallpaper, pipe, brick, masonry, asphalt, and other construction materials from razed buildings and other structures	Demolition sites to be used for new buildings, renewal projects, expressways
8. Construction wastes	Scrap lumber, roofing paper, wallpaper, wrapping paper, pipe, metal, brick, masonry, and other construction materials	New construction, remodeling

Table III-1 (Continued)

SOLID WASTES

Type	Composition	Source
9. Special wastes	Hazardous solids and liquids, explosives, pathological wastes, radioactive materials	Households, hotels, hospitals, institutions, stores, industry
10. Sewage-treatment residue	Solids from coarse screens and grit chambers, sludge	Sewage treatment plants, septic tanks, lagoons
11. Water-treatment residue	Solids from coarse screens and grit chambers, sludge	Water treatment plants
12. Human Fecal Matter		
13. Ashes		
14. Open*		
15. Open		
	Agricultural - Field and Seed Crops	
16. Barley	Stalks, vines, green drop, culls, stubble, hulls, lint, seed	Farms and ranches
17. Beans, dry	↓	↓
18. Corn		
19. Cotton lint		
20. Cotton seed		
21. Hay		
22. Oats		

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*Through table, "Open" represents slots left for the possible future addition of other identified wastes.

Table III-1 (Continued)

SOLID WASTES

Type	Composition	Source
23. Alfalfa	Stalks, vines, green drop, culls, stubble, hulls, lint, seed	Farms and ranches
24. Rice		
25. Safflower		
26. Sorghum		
27. Sugar beets		
28. Wheat		
29. Open		
30. Open		
31. Open		
32. Open		
33. Open		
34. Open		
35. Open		
Agricultural - Vegetable Crops		
36. Beans	Vines, stalks, roots, green drop, culls, stalks	Farms and ranches
37. Cabbage		
38. Chinese vegetables		
39. Sweet corn		
40. Cucumbers		
41. Melons		

Table III-1 (Continued)

SOLID WASTES

Type	Composition	Source
42. Onions	Vines, stalks, roots, green drop, culls, stalks	Farms and ranches
43. Peppers		
44. Radishes		
45. Romaine		
46. Squash		
47. Sweet potatoes		
48. Tomatoes		
49. Turnips		
50. Vegetables*		
51. Open		
52. Open		
53. Open		
54. Open		
55. Open		
	Agricultural - Fruit and Nut Crops	
56. Almonds	Prunings, trimmings, culls, green drop	Orchards, farms, and ranches
57. Apricots		
58. Bushberries		
59. Figs		
60. Grapefruit		

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*When considered as a category rather than individual crops.

Table III-I (Continued)

SOLID WASTES

Type	Composition	Source
61. Grapes	Prunings, trimmings, culls, green drop	Orchards, farms, and ranches
62. Lemons		
63. Nectarines		
64. Olives		
65. Oranges		
66. Peaches		
67. Persimmons		
68. Plums		
69. Pomegranates		
70. Strawberries		
71. Walnuts		
72. Open		
73. Open		
74. Open		
75. Open		
	Agricultural - Manures	
76. Cattle	Lignaceous and fibrous organic matter, nitrogen phosphorous, potassium, volatile acids	Farms, ranches, feed lots, slaughter houses, packers, growers, dairies
77. Sheep		
78. Hog		
79. Horse and mule		
80. Chicken		

Table III-1 (continued)

SOLID WASTES

Type	Composition	Source
81. Turkey	Lignaceous and fibrous organic matter, nitrogen phosphorous, potassium, volatile acids	Farms, ranches, feed lots, slaughter houses, packers, growers, dairies
82. Pigeon		
83. Rabbit		
84. Open		
85. Open		
	Industrial*	
86. Cotton trash	Stalks, leaves, lint, seed	Cotton ginning and compressing (0712)**
87. Fruit and vegetable	Hulls, rinds, cores, seeds, vines, leaves, tops, roots, trimmings, pulps, peelings, cobs, shells, stalks, straws, culls	Fruit and vegetable packing (0715) Canneries (2033) Dried fruit and vegetable processing (2034) Frozen-food plants (2037) Prepared-animal-feed plants (2042) Bakeries (2051) Potato-chip plants (2099) Fresh fruits and vegetables (5048)

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* Not including normal municipal-type refuse

**Throughout table, Standard Industrial Classification Code, as developed by U.S. Bureau of Budget.

Table III-1 (Continued)

SOLID WASTES

Type	Composition	Source
88. Poultry	Manure, litter, dead poultry, eggs	Poultry hatcheries (0723)
	Flesh, fat particles, offal, manure, feathers, bone, grease	Poultry dressing and packing (2015)
89. Animal	Flesh, fat particles, hair, bone, grease, paunch manure	Prepared meat (2013) Meat packing (2011)
90. Milk solids	Butterfat, whey, milk protein, sugar (lactose), ash, acid	Dairy products
91. Wines and spirits	Pomace, spent grain, alkalis, activated carbon, diatomaceous earth	Wineries and distilleries (2084
92. Vegetable oils	"Still pitch" (tarry residue) fatty acids, sodium hydroxide, soapstock	Cottonseed-oil mills (2091) Shortening, table oils, and margarine (2096)
93. Tallow	Paunch manure, flesh, fat particles, hair, bone, grease	Tallow production (2094)
94. Cotton, wool, silk	Rags, cloth, detergents, textile fibers	Carpeting and rugs (2272) Work-clothes manufacture (2328) Women's clothing (2339)

Table III-1 (Continued)

SOLID WASTES

Type	Composition	Source
94. Cotton, wool, silk (continued)	Rags, cloth, detergents, textile, fibers	Curtains and draperies (2391)
		Canvas products (2394)
95. Lumber and wood products	Sawdust shavings, wood chips	Sawmills and planing mills (2421)
		Excelsior (2429)
		Millwork plants (2431)
		Wooden containers (2441)
		Cooperage (2445)
		Wood household furniture (2511)
		Lumber, rough-dressed (5098)
96. Chemicals	Toxic chemicals	Agricultural chemicals (2872)
97. Petroleum	Insoluble organic and inorganic salts, sulfur compounds, sulfanic and naphthenic acids, insoluble mercaptides, soaps, waxy emulsions, oxides of metal, phenolic compounds	Petroleum refining (2911)
98. Plastics	Scraps from molding, extrusion, rejects, trimming and finishing	Plastics, extruded and molded (3079)

Table III-1 (Continued)

SOLID WASTES

Type	Composition	Source
99. Masonry	Sand, cement, ceramics, masonry, brick, etc.	Brick plants (3251) Pottery products (3269) Concrete blocks (3271) Concrete pipe (3272) Ready-mixed concrete (3273)
100. Metals	Various scrap metals, toxic chemicals, rejects, cuttings, moldings, trimmings	Metal office furniture (2522) Showcases and fixtures (2541) Gray iron foundries (3321) Insulated wire cable (3357) Fabricated structural steel (3441) Fabricated steel (3443) Sheet-metal work (3444) Farm machinery (3522) Food products machinery (3551) Vending machines (3581)

Table III-1 (Continued)

SOLID WASTES

Type	Composition	Source
101. Seeds	Rejects, toxic chemicals	Seeds and fertilizers (5099)
102. Tires		

Table III-2

"CUSTOMERS" OF SOLID WASTES
(June 1967)

Agency	Responsible Individual	Address	Telephone
	Fresno City		
City Planning Department	John Behrens	City Hall 2326 Fresno St. Fresno, Calif.	266-8031
Department of Public Works	James Martin		
Fire Department	Edwin Wrought Chief		
Human Relations Coordinator	James Aldrich		
Redevelopment Agency	G. Allan Kingston	Security Bank Bldg. Fulton Mall Fresno, Calif.	233-8651
City Parks and Recreation	Howard Homan	3030 E. Harvey Ave. Fresno, Calif.	266-8031
	Fresno County		
County Planning Department	Harold Tokmakian	4499 E. Kings Canyon Rd. Fresno, Calif.	255-9711
County Natural Resources Committee	Clifford Boyer		
Department of Public Works	Clinton Beery		

Table III-2 (Continued)

"CUSTOMERS" OF SOLID WASTES

Agency	Responsible Individual	Address	Telephone
	Fresno County (Continued)		
County Health Department	Dr. William DeFries Health Officer R. E. Bergstrom Director, Environmental Health Ron McLaughlin Dairy Inspection	515 S. Cedar Ave. Fresno, Calif.	485-8000
Local Agencies Formation Commission	Joseph Reich Chairman	County Courthouse Fresno, Calif.	268-6011
Parks and Recreation Department	Rod Maserve	Kearney Park Kearney Blvd. Fresno, Calif.	233-7358
County Agricultural Commission	Edward Corn	1730 S. Maple Ave. Fresno, Calif.	233-3791
County Agricultural Extension Service	Ray Crouch	1720 S. Maple Ave. Fresno, Calif.	233-2284
	Agricultural Organizations and Special County Districts		
Mid-Valley Fire District	William Pennington	210 S. Academy Fresno, Calif.	233-5838
Fresno Irrigation District	Paul H. Willison	1168 N. Millbrook Ave. Fresno, Calif.	233-7161
Consolidated Mosquito Abatement District	Ted Raley	2425 Floral Ave. Selma, Calif.	896-1085

Table III-2 (Continued)

"CUSTOMERS" OF SOLID WASTES

Agency	Responsible Individual	Address	Telephone
Agricultural Organizations and Special County Districts (Continued)			
Fresno Mosquito Abatement District	Ed Davis	2338 E. McKinley Ave. Fresno, Calif.	268-6565
Fresno Metropolitan Flood Control District	Larry Willoughby	Rowell Bldg., Tulare and Van Ness Aves. Fresno, Calif.	264-2926
Fresno County Farm Bureau	Oren (Jim) King	2851 S. Orange Ave. Fresno, Calif.	237-0263
California Fig Institute	Ron Klamm	1205 E. Olive Ave. Fresno, Calif.	264-5011
Wine Institute	Evins Naman	Suite 16, Del Webb Town House Fresno, Calif.	237-1134
Incorporated Cities in Study Area			
Clovis	Earl Nevens City Superintendent	531 Pollasky Ave. Clovis, Calif.	299-4311
Fowler	Ted Emens City Superintendent	221 S. Fifth St. Fowler, Calif.	834-3110
Fresno	John Taylor City Manager	2326 Fresno St. Fresno, Calif.	266-8031
Kerman	Arn Kelton City Superintendent	720 S. Eighth St. Kerman, Calif.	846-9387
Kingsburg	Dick Staley City Superintendent	1401 Draper Kingsburg, Calif.	897-3303

Table III-2 (Continued)

"CUSTOMERS" OF SOLID WASTES

Agency	Responsible Individual	Address	Telephone
Incorporated Cities in Study Area (Continued)			
Orange Cove	Andy Weber City Superintendent	555 Sixth St. Orange Cove, Calif.	626-4488
Parlier	D. J. Herring City Superintendent	580 Tulare St. Parlier, Calif.	646-2767
Reedley	George Emery City Superintendent	853 "G" St. Reedley, Calif.	638-2535
Sanger	Perry Powers City Manager	1300 Jensen Sanger, Calif.	875-4535
Selma	George Burnham City Engineer	1814 Tucker Selma, Calif.	896-1064
State Department of Agriculture			
Bureau of Animal Health	Dr. John Nehay District Veterinarian	2789 S. Orange Ave. and Highway 99 Fresno, Calif.	264-1941
	Dr. G. N. Lucas Laboratory Pathologist	Same	266-9418
Chemistry Spray Residue Laboratory	William Lewis	State Bldg. 2550 Mariposa St. Fresno, Calif.	268-7151
Bureau of Dairy Services	George Hasler		
Field Crops and Agricultural Chemicals	James Kalstrom		
Bureau of Nursery Services	Douglas Brown		

Table III-2 (Continued)

"CUSTOMERS" OF SOLID WASTES

Agency	Responsible Individual	Address	Telephone
	State Department of Public Health		
Bureau of Vector Control	Richard Peters Chief	2151 Berkeley Way Berkeley, Calif.	843-7900
	Earl W. Mortenson	5545 E. Shields Ave. Fresno, Calif.	291-6676
	Paul P. Maier Project Administrator Fresno Solid Waste Management Study		
Bureau of Sanitary Engineering	Edmund S. Cary		
Bureau of Food and Drug Inspections	Richard D. Penrose		
Bureau of Licensing and Certification	Arthur D. Graham		
Bureau of Air Sanitation	John Maga Chief	2151 Berkeley Way Berkeley, Calif.	843-7900
	Other State Agencies		
Department of Highways	Richard E. Deffeback District Engineer	1352 W. Olive Ave. Fresno, Calif.	268-2575
Water Quality Control Board	Charles Carnahan Executive Officer	2424 16th St. Sacramento, Calif.	445-2575
Department of Water Resources	Carl Stetson District Engineer	1720 Fulton St.	268-7151
Division of Soil Conservation	Glen E. Rosander	State Bldg. 2550 Mariposa St. Fresno, Calif.	268-7151

Table III-2 (Continued)

"CUSTOMERS" OF SOLID WASTES

Agency	Responsible Individual	Address	Telephone
	Other State Agencies (Continued)		
Department of Fish and Game	L. H. Cloyd R. C. Lewis Fisheries D. M. Sellick Game Management	1234 E. Shaw Ave. Fresno, Calif.	222-3761
Division of Forestry	Donald Knowlton R. T. Ford **Fire** Prevention Officer	1234 E. Shaw Ave. Fresno, Calif.	222-3717
Fresno State College	Lloyd Dowler Dean of Agriculture School Thomas Evans Dean of Engineering School	North Maple and Shaw Avenues Fresno, Calif.	222-5161
	U.S. Department of Agriculture		
Agriculture Research Service	John Hagen	3525 E. Tulare St. Fresno, Calif.	266-8071
Processed Products Standardization and Inspection Branch	Daniel R. Russell		
Crops Research Division	John Weinberger	2021 S. Peach Ave. Fresno, Calif.	251-8890
Market Quality Research Division	Dr. John Harvey	Same	251-6084

Table III-2 (Continued)

"CUSTOMERS" OF SOLID WASTES

Agency	Responsible Individual	Address	Telephone
	U.S. Department of Agriculture (Continued)		
Stored-Product Insects Branch	Howard D. Nelson Al Yearington	5578 Air Terminal Dr. Fresno, Calif.	291-6671
Soil Conservation Service	Clarence Finch	324 E. Shields Ave. Fresno, Calif.	229-7017
	U.S. Department of Health, Education, and Welfare		
Food and Drug Administration	Robert Thebus	2135 Fresno St. Fresno, Calif.	266-8071
	U.S. Department of the Interior		
Bureau of Reclamation	William F. Crabtree	T. W. Patterson Bldg. Fulton Mall and Tulare St. Fresno, Calif.	266-8071
Bureau of Sport Fisheries and Wildlife	Lawrence G. Wills	2309 Tulare St. (Post Office Bldg.) Fresno, Calif.	
	U.S. Department of Commerce		
Environmental Science Service (Weather Bureau)	Tom Crossan	Fresno Air Terminal Fresno, Calif.	255-5593

Table III-3

PERSONAL INTERVIEWS

Name	Bad Effects	Agency
E. Mortenson D. Linsdale J. Walsh	Flies	California State Department of Public Health Bureau of Vector Control
E. Cary	Water pollution	California State Department of Public Health Bureau of Sanitary Engineering
L. Trundell and E. Crawford (representing C. Carnahan)	Water pollution	California Water Quality Control Board
C. Boyer	Water pollution	County Natural Resources Committee
J. Maga	Air pollution	California State Department of Public Health Bureau of Air Sanitation
R. L. Chass	Air pollution	Los Angeles County Air Pollution Control District
Dr. A. J. Haagen-Smit	Air pollution	California Institute of Technology
E. Mortenson	Rodents	California State Department of Public Health Bureau of Air Sanitation
E. E. Hogan	Rodents	Fresno County Agricultural Commissioner's Office
Dr. W. DeFries	Human disease	Fresno County Health Department
Dr. T. G. Hanks	Human disease	Aerojet-General Corporation Life Systems Division
Dr. L. Saylor	Human disease	California State Department of Public Health
Dr. J. Nehay	Animal disease	California State Department of Agriculture Bureau of Animal Health

Table III-3 (Continued)

PERSONAL INTERVIEWS

Name	Bad Effects	Agency
L. Dowler R. Glim	Animal disease	Fresno State College
E. Mortenson	Insects other than flies	California State Department of Public Health Bureau of Vector Control
H. Magy	Insects other than flies	California State Department of Public Health Bureau of Vector Control
C. Diener	Safety Hazards	Fresno City, Department of Public Works Division of Waste Disposal
E. Wrought	Safety hazards	Chief, Fresno City Fire Department
C. Beery	Safety hazards	Fresno County Department of Public Works
P. P. Maier	Odor	California State Department of Public Health Bureau of Vector Control
C. Jones	Odor	Fresno County Health Department
W. Slipe	Odor	Fresno City, Community Development
J. Kalstrom	Crop damage and plant disease	California State Department of Agriculture Field Crops and Agricultural Chemicals
Dr. J. Harvey M. Covey	Crop damage and plant disease	U. S. Department of Agriculture Agriculture Research Service Crops Research Division
Dr. L. Leach	Crop damage and plant disease	University of California at Davis Department of Plant Pathology
R. E. Bergstrom	Land pollution	Fresno County Health Department

Table III-3 (Continued)

PERSONAL INTERVIEWS

Name	Bad Effects	Agency
W. Norman	Land pollution	Merced County Health Department
C. Finch	Land pollution	U.S. Department of Agriculture Soil Conservation Service
P. P. Maier	Unsightliness	California State Department of Public Health Bureau of Vector Control
H. Tokmakian	Unsightliness	Fresno County Planning Department
H. DuPertuis	Unsightliness	DuPertuis and Hesse, Architects Merced, California
D. Mengle	Toxicity	California State Department of Public Health
W. Lewis	Toxicity	California State Department of Agriculture Chemistry Spray Residue Laboratory
Dr. C. Einert	Toxicity	California State Department of Public Health

IV. PERFORMANCE-SCORING PROCEDURE

A. GENERAL CONSIDERATIONS

The traditional method of determining the suitability of a system or of selecting between several alternative systems is to gage theoretical or measured performance against a set of performance specifications or standards. The customer specifies what is required of a system or device in terms of measurable output standards, and the designer uses this as the basis for evaluating alternative designs and for measuring the ultimate suitability of the final operating system.

In the waste management field, in general, and particularly in solid waste management, there are essentially no output standards. The standards which have evolved are the result of emergency pressures and are directed almost entirely toward the alleviation of a disease potential or the removal of waste from direct sight and contact at the least possible cost.

The basis of the procedure advanced in this study is the postulation that effectiveness can be expressed or measured in terms of the degree to which the system decreases the environmental or bad effects of solid wastes. If, for example, a unit quantity of a given waste lying open on the ground is the constant source of 1 unit of odor, a control system such as a tarpaulin cover that cuts this odor in half could be said to have a relative effectiveness of 50%, a tightly sealed container one of 100%.

The performance-scoring procedure developed in this program identifies a series of bad effects (B. E.) and quantifies these bad effects for various wastes in various conditions to produce a table of solid waste B. E. scores. Using these scores, any waste management system's performance effectiveness can be gaged by the degree of reduction of these environmental or bad effects.

While the procedure developed herein is still subject to refinement, it is a significant step in the direction of the development of performance standards by which the effectiveness of competing waste management systems can be measured for use in a systems approach to cost effectiveness studies.

B. PROCEDURE DEVELOPMENT

1. Bad Effects

To arrive at a method of scoring waste management system effectiveness in reducing bad effects of solid waste, it was necessary to first establish what those bad effects were. Environmental health experts from Aerojet-General Corporation, Engineering-Science, Inc., and the State of California considered the problem, reviewed the subject literature, and arrived at the conclusion that 13 bad effects need be considered. These are:

1 - Flies
2 - Water Pollution
3 - Air Pollution
4 - Rodents
5 - Human Disease
6 - Animal Disease
7 - Insects Other Than Flies
8 - Safety Hazards
9 - Odor
10 - Plant Disease
11 - Land Pollution
12 - Unsightliness
13 - Toxicity

A comprehensive discussion of the relationship of these effects to solid wastes is included in Appendix A, Volume II, of this report.

2. Waste Conditions

In addition to establishing the bad effects, the studies reported in Section III also delineated the major conditions or states in which solid waste exists or are likely to exist in the Fresno Region for the duration of the study period. These conditions are:

1 - Unmanaged

2 - Spread on Ground

3 - Piled on Ground

4 - Piled on Slab

5 - Containers Open

6 - Containers Closed

7 - Transport Open

8 - Transport Closed

9 - Grinding

10 - Spray Irrigation

11 - Incineration

12 - Open Burning

13 - Composting

14 - Lagooning

15 - Landfill

16 - Buried

17 - Open Dump

18 - Plowed in Ground

19 - Pit Disposal

A definition and description of each of these conditions can be found in Section III.

While it is not intended to imply that these conditions are the only possible conditions in which solid wastes can exist, it is believed that all major conditions are covered, and that the majority of methods and unit processes for handling solid waste can be accommodated by a broad definition of the conditions listed.

For any waste system postulated, the resulting unit processes will place the waste in a variety of these conditions. Through the procedures developed in this study the bad effects of the various wastes with respect to the waste conditions resulting from any proposed management system can be rated.

3. Weighted Bad Effect Scores

The bad effects scores devised in this study have two basic components; Basic Bad Effects Scores, a function of the waste and the condition in which the waste is placed and Influence Coefficients, a function of the subregion where the effects occur. The subregion break down used in this study is Industrial, Municipal, Interface, and Agricultural. The designations indicate differences in land usage and population densities as shown in Table IV-1.

a. Basic Bad Effects Scores

(1) Relative Contribution Ratings

With the establishment of the lists of bad effects, waste conditions and an inventory of different wastes which are produced in the region, the next requirement was to obtain a numerical value for each pertinent waste that represents its relative contribution to each bad effect under each condition. Because such data are only sparsely available in the literature, Aerojet-General approached experienced practitioners in the sanitary-engineering and environmental-science fields for value judgments to use in the scoring system. Although ideally, only measured and quantified data should be used for this purpose; the use of value judgments was considered as the best available alternate.

To ascertain the relative contribution of a given waste under a given condition to possible bad effects, score sheets for each effect were completed by selected State and local Fresno experts in various fields and agencies (Bureau of Vector Control, Water Quality Control Board, Bureau of Air Pollution

Control, etc.). These initial score sheets (Table IV-2) were filled in on a 0 to 5 rating scale in which 0 indicates no significant contribution and 5 indicates the highest relative contribution to a bad effect.

The rating scale was arrived at by the following reasoning: To obtain some relative relationship between conditions or types of waste, a finer scale than good or bad was needed. In this type of subjective decision, however, too fine a scale would be impractical. Rating from 0 to 5 was selected as a reasonable compromise.

The experts were given the following guidelines:

(a) List across the top of a score sheet all the wastes considered as contributing to the particular bad effect being scored under any of the stated conditions.

(b) Consider one condition at a time and score the relative contribution (from 0 to 5) that unit quantities of each waste make to the bad effect when placed in that condition.

Scores for each bad effect were provided by more than one expert and the results averaged as shown in Table IV-2.

(2) Relative Condition Rating

The scores obtained above reflect only the relative contributions of wastes in a given condition. To arrive at a score that reflects the relative contributions of wastes in different conditions, as well as wastes in the same condition, it was necessary to obtain a relative-condition rating that represents the effects of different conditions in changing the magnitude of the waste contribution to a bad effect. This was done by asking the experts (a) to consider unit quantities of the combined wastes that contribute to the bad effect as being in each of the stated conditions, and (b) to rate them from 0 to 5, where 0 indicates that the condition virtually eliminates the particular bad effect and 5 indicates that the condition is the worst possible way of handling the wastes. This rating is shown in the right-hand column of Table IV-2.

Using a digital computer to multiply the condition rating, just described, by the earlier waste contribution rating for each bad effect, scores were obtained that represent the relative contribution to a bad effect of unit quantities of each waste under each condition. These are designated as Basic Bad Effect Scores. Sample results are shown on a computer printout sheet presented as Table IV-3.

b. Influence Coefficients

As it stands, Table IV-3 lacks two features necessary for actual applications. The scores were developed for the Fresno Region in general, and to be useful must be weighted to reflect the relative importance of the various bad effects in terms of the types of subregions within the region. As an example, it would be a mistake to consider a bad effect such as crop damage to be as important in the city as on the farm. In addition, the values presented do not consider the many other contributors to the generation of bad effects being weighed, other than solid wastes. Consequently, a weighting factor is needed to reflect what portion of the bad effects are caused by solid wastes. Without such weighting, considerable time and money might be devoted, for example, to the design of a system that will emphasize the reduction of wastes that contribute to human disease in the city, even though solid wastes contribute very little to human disease in the city. As previously indicated, four subregions were established for the Fresno Region on the basis of differences in population density and land use. These are Industrial, Municipal, Agricultural-Municipal Interface, and Agricultural.

The interface subregion combines all problems of the agricultural and municipal subregions. The solid waste problems created in a purely agricultural area though massive are not generally serious, due to the low population density. However, when the municipal area grows rapidly and with little control into the agricultural region, the increasing population suffers the gross problems created in the agricultural area. For this reason, the interface subregion appears to be very important in the management of solid wastes and the environmental problems they create. The population density of each of these types of subregions is shown in Table IV-1.

(1) Relative Importance

The relative-importance weighting factors for each subregion were determined by a two step procedure; first, an order of importance was established and then numerical values were assigned relative to the established order of importance.

The order of importance was determined by experts in the sanitary-engineering field using a method known as forced decision making: One bad effect at a time was compared with each of the other bad effects, and a decision was made as to the more important; in each decision the more important one was scored 1, and the less important one was scored 0. These decisions were then added up, row by row, to obtain the order of importance. The number of decisions that must be made can be calculated by the theory of combinations:

$$D = \frac{N(N-1)}{2}$$

where

D = total decisions

N , number of bad effects considered

Numerical values representing relative importance were then judged by program and State personnel and were assigned to each bad effect following the order determined above. The numerical values assigned on a scale of 0 to 100 are based on the judgment of experts and are not proportional to the order of importance. Table IV-4 illustrates the method of determining the order of importance and relative-importance factors for the four subregions.

(2) Relative Contribution

The next requirement for the establishment of the Influence Coefficients was the determination of the relative-contribution of solid wastes to each bad effect in each subregion as compared to all factors contributing to the bad effects. The relative-contribution weighting factors were established by sanitary engineers in conjunction with the State and Fresno County officials for each subregion, by estimating the percentage contribution of solid waste to the various bad effects.

For example, in the municipal subregion solid wastes are virtually the only contributor to fly breeding and therefore receive a value of 100, whereas, they contribute very little to human disease and thus receive a value of only 2. These data indicate that careful attention should be given to controlling fly-breeding wastes. Table IV-5 delineates the relative contribution factors established for the various wastes in the four subregions.

(3) Weighted Relative Importance & Influence Coefficient

The relative importance factor was multiplied by the relative contribution factor resulting in a numerical weighted relative importance factor for each bad effect in each subregion. The numerical values for all the bad effects in each subregion were then added together. The influence coefficient for each bad effect in each subregion was then established as the ratio of the weighted relative importance factor for an individual bad effect to the sum of all the weighted relative importance factors for the total region. Table IV-6 lists the weighted relative importance factors and influence coefficients for each bad effect in each subregion.

c. Total Weighted Bad Effects Scores

To obtain the total weighted bad effects scores, the influence coefficient for each bad effect from Table IV-6 was then multiplied by the Basic bad effect scores for each waste under each condition as listed in Table IV-3. Table IV-7 presents sample results of this multiplication. The complete results consist of one sheet for each waste for each type of subregion; the example given is for waste residential rubbish in a municipal subregion. As seen in Table IV-7, the tabulated results are added horizontally to provide a total weighted bad effect score for a unit quantity of the given waste under a given condition in a particular type of subregion. To account for the fact that in certain geographic locations water pollution is not a problem, two separate additions are made in Table IV-7. One addition includes all the bad effects (Column 1 in Table IV-7) and the other assumes that the score for water pollution in zero (Column 2 in Table IV-7).

Mathematically, the overall equation used to arrive at the score in Column 1 of Table IV-7 is as follows:

$$\left.\begin{matrix}\text{Total weighted}\\ \text{bad effect}\\ \text{score}\end{matrix}\right\} = \sum_{B=1}^{N} \underset{\left[\text{Par. 3a(1)}\right]}{\begin{bmatrix}\text{unit waste contri-}\\ \text{bution to a}\\ \text{bad effect}\end{bmatrix}_B} \underset{\left[\text{Par. 3a(2)}\right]}{\begin{bmatrix}\text{condition contribu-}\\ \text{tion to a bad}\\ \text{effect}\end{bmatrix}_B} \underset{\left[\text{Par. 3b(3)}\right]}{\begin{bmatrix}\text{influence}\\ \text{coefficient}\end{bmatrix}_B}$$

where

B = bad effect

N = number of bad effects being considered

This equation is repeated for each waste under each condition. Column 2 is generated by subtracting the bad effect score for water pollution from Column 1.

The scores in the two right-hand columns of Table IV-7 will be used as the basis for scoring the relative effectiveness of alternative waste management concepts or systems. A more convenient format to work with when applying these scores is shown in Tables IV-8 and IV-9. Here all the weighted bad effect scores are listed on a single table along with the related wastes and conditions. Table IV-8 is based on Column 1 of Table IV-7 (water pollution considered possible) and Table IV-9 on Column 2 of Table IV-7 (water pollution considered not possible).

Working from these tables, a system designer has a basis for selecting the better performing conditions under which he might wish to place the wastes for any particular subregion, with the lower score indicating a more effective method. The designer would not dispose of garbage in open dumps in the city, in preference to landfills, but this might be a perfectly valid method of disposal for some wastes in an agricultural district, depending on relative scores and final costs. The "open" listings in the wastes column represent slots left for the possible future addition of other wastes.

The bad effect scores obtained in this step are for a unit quantity of waste. The possibility of nonlinear relationships between increasing quantities of various wastes and their subsequent scores was considered. Insufficient evidence or empirical relationships were found that would substantiate a nonlinear relationship. Consequently, based on the best available information, bad effect scores that have been generated for a unit quantity of waste can be used to obtain a score for any number of units of waste by multiplying the per-unit score by the quantity being considered.

4. Candidate System Information and Performance Scoring

Some 82 different solid wastes are presently being generated in the Fresno Region. Although theoretically, handling systems can be evolved to reduce and minimize the bad effects from each type of waste; practical application requires the lumping together for treatment of as many as possible of the individual wastes. In addition, to be effective, any system postulated must consider the current practices habits, and budgetary limitations existing in the region. Concerted effort should thus be directed at those wastes and those methods that can be altered at minimum cost with maximum reduction in regional bad effects.

The waste management procedures proposed for any candidate system will result in wastes being handled in several of the 19 conditions previously described in this section. These conditions, with the exception of unmanaged, are categorized into four functions for the purpose of this study. These are storage, transportation, processing, and disposal. The conditions pertaining to each function are as follows:

Storage

- Spread on Ground
- Piled on Ground
- Piled on Slab
- Container Open
- Container Closed

Transportation

- Transport Open
- Transport Closed

Processing

- Grinding
- Spray Irrigation
- Incineration
- Open Burning
- Composting

Disposal

- Landfill
- Buried
- Open Dump
- Plowed in Ground
- Pit Disposal
- Spread on Ground
- Lagooning

In order to account for the differences in accumulation effect from those conditions that are temporary (transient) and those that place the waste in its final condition (disposal), separate scores are maintained. The transient procedures include all of the conditions pertaining to storage and transportation, with the exception of spread on ground which may be either transient or disposal. Processing and disposal conditions are all scored with the disposal procedures with the exception of grinding which is scored as transient.

To facilitate concept evaluation a standardized data form has been developed. This form has places for entering the system total bad effects scores separately for the transient and disposal procedures for all wastes being managed in a particular subregion. Figure IV-1 is a sample System Concept Data Form.

a. Transient System Information and Scoring

The information needed to score the transient portion of a concept includes (1) the types of wastes to be managed, (2) description of all the transient conditions being used, and (3) the average amount of each type of waste that will exist, at all times, in each transient condition.

In determining the average amount of waste in the various transient conditions, consideration must be given to changes in waste load that may occur over the period for which the concept is being evaluated. The waste load to be used is the load that exists at the end of the evaluation period. This information is then used in the following equation to yield the performance score for the transient system:

$$\left.\begin{array}{c}\text{Transient}\\ \text{performance}\\ \text{score}\end{array}\right\} = \Sigma_{C=1}^{M} \left[\begin{array}{c}\text{bad effect score for given}\\ \text{waste in given}\\ \text{transient condition}\\ \text{(from Table IV-8 or IV-9)}\end{array}\right]_C \left[\begin{array}{c}\text{average amount of}\\ \text{given waste in given}\\ \text{transient condition}\\ \text{(from Figure IV-1)}\end{array}\right]_C$$

where

C = transient condition

M = number of transient conditions in system

(SAMPLE SYSTEM)

EVALUATION YEAR 2000

SYSTEM DESIGNATION Truck & Landfill

SUBREGION TYPE Municipal

CONDITIONS TYPE OF WASTE	Garbage	Mixed Garbage	Dead Animals	Sludge (Sewage)	Alfalfa	Melons	Apricots	Grapefruit	Lemons	Oranges	Plums	Hog Manure	Chicken Manure	Rabbit Manure	Fruit & Vegetable	Animal
1. UNMANAGED																
2. STORAGE																
2A. SPREAD																
2B. PILED ON GROUND	1.5															
2C. PILED ON SLABS																
2D. CONTAINER - OPEN																
2E. CONTAINER - CLOSED	5.25															
3. TRANSPORT																
3A. TRANSPORT - OPEN	.281															
3B. TRANSPORT - CLOSED																
4. PROCESSING																
4A. GRINDING																
4B. SPRAY IRRIGATION																
4C. INCINERATION																
4D. OPEN BURNING																
4E. COMPOSTING																
4F. LAGOONING																
5. DISPOSAL																
5A. LANDFILL	547															
5B. BURIED																
5C. OPEN DUMP																
5D. PLOWED INTO GROUND																
5E. PIT DISPOSAL																

INSTRUCTIONS

1. Fill in system designation with an appropriate name to describe the system being considered.
2. Fill in the subregion type being considered (Agricultural, Municipal, Industrial, or Interface).
3. For each transient condition being considered, fill in the column under the types of wastes being handled with the average amount (tons) of this type of waste that will exist, at all times, in the particular condition.
4. For each final condition being considered, fill in the column under the types of wastes being handled, with the amount of this type of waste (in tons/year) being disposed of in this manner.
5. Some of the conditions listed may be either transient or final; thus, the convention of transient amount/final disposal amount is used.

Figure IV-1. Waste Management System Concept Data Form

b. Final Disposal-System Information and Scoring

The information needed to score the final disposal portion of a system concept includes (1) the types of wastes to be managed, (2) the waste load in tons/year for each waste, and (3) identification of each of the final disposal methods being used. The waste load to be used in scoring each waste is the projected quantity for the year for which the system concept is designed. If more than one final disposal method is used, Items (1) and (2) will have to be stipulated for each method. This information is then used in the following equation to yield the disposal performance score:

$$\left.\begin{array}{c}\text{Final disposal}\\\text{performance}\\\text{score}\end{array}\right\} = \Sigma_{C=1}^{P} \left[\begin{array}{c}\text{bad effect score}\\\text{for given waste}\\\text{in given final}\\\text{conditions (from}\\\text{Table IV-8 or IV-9)}\end{array}\right]_C \left[\begin{array}{c}\text{waste loading for}\\\text{given waste in}\\\text{given final con-}\\\text{dition (from}\\\text{Figure IV-1)}\end{array}\right]_C$$

where

C = final disposal condition

P = number of final disposal conditions in system

c. Total System Score

Solution of the equations above yields performance scores for one particular type of waste in a given subregion. To obtain scores for the management of several types of waste (in the given subregion) the equations are solved for each type and the results are added (see Table IV-10 for a hypothetical example). The total score thus obtained for the transient portion represents a value based on an average fixed quantity of waste in the given conditions at all times (7 days a week, 24 hours a day). The score for the disposal portion is based on the projected yearly quantities of the various wastes in the various conditions in the year being evaluated.

The preliminary performance scoring procedure described in the Interim Report contained an accumulation factor in the equation for the Final Disposal Performance Score. This factor was included in an attempt to account for the rate at which bad effects decrease with time in the postulated disposal conditions.

The factor depends on the rate of degradation of solid wastes in those conditions. Further consideration indicated that no sound information regarding the degradation rates was available. The accumulation factor was, therefore, removed from the final procedure. It is felt, however, that this is an area where additional studies may produce valuable data for increasing the precision of the Performance Scoring Procedure.

C. SYSTEM EFFECTIVENESS COMPARISONS

The subjective nature of the scoring data used in this procedure makes it impossible to interpret the performance scores of any proposed group of systems concepts in terms of absolute effect on the environment. To obtain meaningful results for system comparisons, the score of the existing system of management or lack of management is also determined and the scale used in comparing the effectiveness of competing systems is the percentage improvement in total bad effects score of the proposed system over that of the existing.

As previously indicated, separate scores are maintained in the procedure for the transient and disposal components. On the assumption that each of these components is of equal importance to society, the final total system improvement is the average of the improvements of the transient and disposal components. For example, if the score of two competing systems and the existing system were as follows:

	Score Transient	% Impr.	Score Disposal	% Impr.	% Improvement Tot. System
Existing System	3	--	3,000	--	--
New System A	2	33	750	75	54
New System B	1	67	1,500	50	58

The comparison indicates that System A results in an overall improvement of 54% while System B, being more effective, results in 58% reduction in regional bad effects when compared to the existing system.

Whether either of these systems would be selected for implementation would be determined primarily on the cost per percentage-point reduction and on what the community would choose to pay. The absolute value of the performance score in terms of score vs effect will be determined through the experience of living with systems of various scores.

D. SAMPLE SYSTEM

The information needed to score a sample system is derived below to demonstrate the use of the data forms (Figure IV-1).

Sample problem: Dispose of 1.5 tons/day of garbage generated in a municipal subregion.

The proposed management concept to be scored is that of placing the garbage in closed cans, which are picked up once a week and transported in an open truck to a landfill. It is assumed that the trucks operate on a 6-day week (8-hour workday, with a 1-hour lunch break). It is also assumed that collection requires 7 hours and that 1 hour is needed for a round trip to the landfill at the end of the day. On the average, therefore, the trucks are half full for 8 hours (collection time plus 1-hour lunch break) and completely full for 1/2 hour (half of round trip to the landfill site). It is also assumed that the garbage is piled on the ground at the landfill site before being covered in such a manner that a 1-day accumulation is exposed on the average at all times. In block-diagram form,

Closed cans, weekly pickup	Open truck daily operation	Piled on ground, daily operation	Landfill, daily operation

The average amount of garbage in closed cans at all times (24-hour/day, 7-day/week) is

$$\frac{(1.5 \text{ tons/day})\ (7 \text{ days/week})}{2} = 5.25 \text{ tons}$$

The average amount of garbage in open trucks at all times (24-hour/day, 7-day/week) is

$$\frac{1.5 \text{ tons/day } (8/24 \text{ day})}{2} + 1.5 \text{ tons/day } \frac{0.5 \text{ day}}{24} = 0.281$$

No adjustment is necessary for the 6-day workweek because 1.5 tons/day is the average daily amount - i.e., if the waste load was first adjusted by $\frac{7}{6}$ to show the increase caused by the 6-day pick up period, a further adjustment of $\frac{6}{7}$ would be necessary to account for the 1 day a week that there is no garbage in trucks; thus, there is no net effect.

The average amount of garbage piled on the ground is

$$(1.5 \text{ tons/day})(1 \text{ day}) = 1.5 \text{ tons}$$

The waste loading in the landfill is

$$(1.5 \text{ tons/day})(365 \text{ day/year}) = 547 \text{ tons/year}$$

These data are entered in the sample data form as shown in Figure IV-1 and would be used in the appropriate equations of Section IV, B if this system were being scored. In the scoring for an actual system, many more wastes would be considered and many more columns in the data form would be filled in.

This example assumes that waste conditions occur in the same subregion, which obviously is not always the case. If a system is proposed in which some conditions are outside the subregion being considered, those conditions are scored as part of the system for the subregion where they do occur. In the example, landfill could have been considered to occur in an agricultural subregion. In that case, landfill with its attendant waste load would not be scored for the municipal subregion but would be scored for the agricultural subregion. Because of this requirement, it is mandatory that entire interacting regions, such as the Fresno Region, be considered in evaluating waste management systems and not just specific local areas.

E. COMPUTER PROGRAM

In determining the weighted bad effects scores described in Section IV, B3 of this report, more than 25,000 bits of numerical data are utilized. The mathematical routine used to manipulate these data into the desired results is simple; however, the number of calculations is large and the presentation of the results is a significant clerical task. Because of this, it is advantageous to use a digital computer since the computer can perform the calculations rapidly and feed the results to a printer to provide tabulated presentation.

The program developed to generate performance scores for waste management systems maintains as stored data the weighted bad effect scores thus calculated. If a system requires the management of a small number of wastes in only a few conditions, it is feasible to utilize the program print out of the summarized bad effects table, pick off the scores for the wastes being managed in the particular conditions, and perform the required mathematics manually. If, however, a large number of wastes in many different conditions for several systems are being evaluated, it becomes almost mandatory to use the performance scoring computer program.

It should be noted that the weighted bad effects developed as part of the performance scoring computer program are unique to the Fresno Region. To use the program for a region other than Fresno will probably require changes to adapt the program to different wastes and particularly different influence coefficients.

The procedure necessary for inputting data to the performance scoring program is delineated in Table IV-11.

Table IV-1

SUBREGIONAL CATEGORIES

Subregion	1 Population Density persons/acre	2 Population Density persons/Sq. Mile
Municipal (residential and commercial)	5 and over	3200 and over
Interface (residential, commercial, and agricultural)	From less than 5	Between 3199 and 64
Agricultural	Under 0. 1	Under 64
Industrial	High population density - short intervals	

Table IV-2

SOLID WASTES PROBLEM DATA

*Ratings identical for all wastes in category shown

FLIES

Scored by: D. Linsdale, J. Walsh, E. Mortenson

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	9 SPECIAL WASTES	10 SEWAGE TREAT. RES.	13 HUMAN FECAL MATTER	18 CORN	23 ALFALFA	27 SUGAR BEETS
UNMANAGED	4.7	2	4	2.7	5	5	4.7	4.7	1	0	2
MANAGED:											
STORAGE											
Spread	1	1	1	0.3	5	4	0	3	0	0	0
Piled on ground	5	2.7	4.5	2.7	5	5	4.7	5	2	2	3
Piled on slabs	5	2.7	4.5	2.7	5	5	4.7	5	2	3	3
Container - open	5	3	5	3	5	5	3.7	4.7	0	2	0
Container - closed	5	2.3	4.5	3	5	5	2.7	3.7	0	2	0
TRANSPORT											
Open	0	0	0	0	0	0	0	0	0	0	0
Closed	0	0	0	0	0	0	0	0	0	0	0
PROCESSING											
Grinding	0	0.7	0.5	0	2	2	0	1.7	0	0	1
Spray irrigation	0	0.3	0	0	1	1.7	0	3	0	0	1
-- Incineration	0	0	0	0	0	0	0	0	0	0	0
— Open burning	3.3	1.7	2.5	0.7	4	3	3	3.3	1	1	3
-- Composting	0	0	0	0	0	0	0	0	0	0	0
Lagooning	0	0	0	0	0	0	0	0	0	0	0
DISPOSAL											
Landfill	0	0	0	0	0	0	0	0	0	0	0
Buried	4.3	2.7	4	1.7	4.3	4.3	1.7	2.7	0	0	0
Open dump	5	3.3	4.5	2.7	5	5	4.7	5	2	2	3
Plowed into ground	3	1.3	2.5	1.3	1.7	2.3	0.7	3.3	0	0	0
Pit disposal	5	3	4.5	1.7	4.3	2.7	3	4.3	0	0	2

CONDITIONS / TYPE OF WASTE / WASTE NO.	37 CABBAGE	41 MELONS	42 ONIONS	48 TOMATOES	57 APRICOTS	59 FIGS	60 GRAPEFRUIT	61 GRAPES	62 LEMONS	63 NECTARINES
UNMANAGED	2	3.7	2	4.7	2.7	2	2	2	2	2.[illegible]
MANAGED:										
STORAGE										
Spread	1	3	0	1.7	1	1.5	1	1	1	2.5
Piled on ground	4.5	4.3	5	4.7	3.7	3	3	3.3	3	4
Piled on slabs	4.5	4.3	5	4.7	3.7	3	3	3.3	3	4
Container - open	3.5	3.7	5	4.3	3	1.5	1	3.3	1	3
Container - closed	3	3.7	5	4.3	3	1.5	1	3.3	1	3
TRANSPORT										
Open	0	0	0	0	0	0	0	0	0	0
Closed	0	0	0	0	0	0	0	0	0	0
PROCESSING										
Grinding	0	0	0	0	0.7	0	0	0	0	0.5
Spray irrigation	0	0	0	0	0.7	0	0	0	0	0.5
-- Incineration	0	0	0	0	0	0	0	0	0	0
— Open burning	3.5	4	3	4.3	3.3	2	2	3.3	2	2.5
-- Composting	0	0	0	0	0	0	0	0	0	0
Lagooning	0	0	0	0	0	0	0	0	0	0
DISPOSAL										
Landfill	0	0	0	0	0	0	0	0	0	0
Buried	1	1	3	2.3	1	0.5	0	1.3	0	0
Open dump	4.5	4.3	5	4.7	3.7	3	3	3.3	3	4
Plowed into ground	1.5	2	1	1.7	0.3	0.5	0	0.3	0	0.5
Pit disposal	0	0	4	0.3	0	0.5	0	0	0	0

CONDITIONS / TYPE OF WASTE / WASTE NO.	65 ORANGES	66 PEACHES	68 PLUMS	71 WALNUTS	76 CATTLE MANURE	77 SHEEP MANURE	78 HOG MANURE	79 HORSE & MULE MANURE	80 CHICKEN MANURE	81 TURKEY MANURE	82 PIGEON MANURE	83 RABBIT MANURE	86 COTTON TRASH	87 FRUIT & VEGETABLE	88 POULTRY	89 ANIMAL
UNMANAGED	1.7	3	2.3	1	4.7	1	4.7	3.3	5	1	2.7	3	2	4.7	4.7	4.7
MANAGED:																
STORAGE																
Spread	1	1.7	1.3	1	0	0	0.7	0	0	0	0	0	0	1	2.3	3.3
Piled on ground	3	4.7	4	2	5	3	5	5	5	3	3.3	3.7	2.3	5	4.7	4.7
Piled on slabs	3	4.7	4	2	5	3	5	5	5	3	3.3	3.7	2.3	5	4.7	4.7
Container - open	1.7	3.7	2.7	0	3	1	3	3.3	3.7	2	3	2.7	1.3	4	4.3	4.3
Container - closed	1.7	3.7	2.7	0	2.7	1	2.7	2.7	3	2	2.3	2	1	3	4.3	4.3
TRANSPORT																
Open	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Closed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROCESSING																
Grinding	0	0.7	0.7	0	0	0	0	0	0	0	0	0	0	0.3	1	0.7
Spray irrigation	0	0.7	0.7	0	0	0	0	0	0	0	0	0	0	0.3	0.3	0.3
-- Incineration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
— Open burning	2.7	4	3.3	0	3.7	1	4.3	3.3	4.7	2	3	3.3	0.7	4.7	3.7	4
-- Composting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lagooning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DISPOSAL																
Landfill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buried	0.3	1.7	1	0	4.3	2	4	3	3.7	2	1.7	2	0.3	2.7	2.7	2.7
Open dump	3	4.7	4	2	5	3	5	5	5	3	3.7	3.7	2.3	5	4.7	4.7
Plowed into ground	0	1	0.3	0	1	0	1.3	1	1	0	1	1	0	1	1	1.3
Pit disposal	0	0	0	0	2.7	1	1.7	1.3	3.3	1	0.7	1.3	0	1.3	1.3	1.3

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

FLIES
(continued)

CONDITIONS / TYPE OF WASTE / WASTE NO.	90 MILK SOLIDS	91 WINE & SPIRITS	92 VEGETABLE OILS	93 TALLOW	101 SEEDS	CONDITIONS
UNMANAGED	3	3.7	3	5	2.5	4.3
MANAGED:						
STORAGE						
Spread	0	0	0	2.5	0	1
Piled on ground	3	3.7	5	5	3.5	5
Piled on slabs	3	3.7	5	5	3.5	4.7
Container - open	5	3	4	4.5	2	3.7
Container - closed	4	3	2	4.5	1	3
TRANSPORT						
Open	0	0	0	0	0	0
Closed	0	0	0	0	0	0
PROCESSING						
Grinding	0	0	0	0.5	0	0.7
Spray irrigation	0	0	0	0	0	0.7
Incineration	0	0	0	0	0	0
Open burning	3	3	2	3	2	3.7
Composting	0	0	0	0	0	0
Lagooning	0	0	0	0	0	0
DISPOSAL						
Landfill	0	0	0	0	0	0
Buried	2	2	3	3	1.5	2.3
Open dump	3	3.7	5	5	3.5	5
Plowed into ground	0	0.3	0	0	0	1.3
Pit disposal	0	0.3	0	1.5	0	2.3

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

*Ratings identical for all wastes in category shown

WATER POLLUTION

Scored by: C. Boyer, E. Cary,
E. Crawford, L. Trumbull

CONDITIONS TYPE OF WASTE WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	6 ABANDONED VEHICLES	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	9 SPECIAL WASTES	10 SEWAGE TREAT. RES.	11 WATER TREAT. RES.	12 ASHES	13 HUMAN FECAL MATTER	16-28 FIELD & SEED CROPS*	36-49 VEGETABLE CROPS*	FRUIT CROPS*	NUT CROPS*	MANURES*	80 CHICKEN MANURE	86 COTTON TRASH	87 FRUIT & VEGETABLE	88 POULTRY	89 ANIMAL	90 MILK SOLIDS	91 WINE & SPIRITS	92 VEGETABLE OILS	93 TALLOW	94 COTTON, WOOL, & SILK	95 LUMBER & WOOD PRODS.	96 CHEMICALS	97 PETROLEUM	98 PLASTICS	99 MASONRY WASTES	100 METALS	101 SEEDS	102 TIRES	CONDITIONS
UNMANAGED	2.5	2	2.7	2.5	2.5	1.7	1	1	5	2	1.7	0.5	4	1	1	1	1	2.3	1.7	0.5	2	3.3	3.7	3	1.5	1	3	1	1.5	5	3	2	1.3	1.7	2.5	1	3.3
MANAGED:																																					
STORAGE																																					
Spread	2.5	2	2	2.5	2.5	1	0.5	0.5	4.3	1	1	0.5	3.3	1	1	1	1	2.7	2	1	1.3	2	2	4	2	1	3	0	2	5	3.7	2	0.7	1.3	3	0.5	2.3
Piled on ground	2.5	2	2.7	2	2	0.7	0.5	0.5	4	1	1.7	0.5	4	1	1	1	1	3	2.3	0.5	2.3	2.3	2.3	4	2	1	2.5	0	1.5	5	2.7	1.5	0.7	1.3	3	0	2
Piled on slabs	2	1.5	3	1	1	0.7	0	0	2	0.7	1	0	3.3	0.5	0.5	0.5	0.5	1.7	1.7	0.5	0.7	1.7	1.7	3	1	1	2	0	0	2.5	1.7	0	0	0	0	0	1
Container - open	1.5	1	1	0.5	0.5	0.3	0	0	1	0.7	0.7	0	1.3	0	0	0	0	1	1	0	0.3	1	1	2	0.5	0.5	1.5	0	0	2.5	1	0	0	0	0	0	0.3
Container - closed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRANSPORT																																					
Open	0.5	0.5	0.3	0.5	0.5	0.3	0.5	0.5	0.7	0.3	0.3	0.5	1.7	0	0	0	0	1	1	1	0.3	0.7	0.7	1	0.5	0.5	1	0	0	2	0.7	0.5	0.3	0.3	0	0.5	0.3
Closed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROCESSING																																					
Grinding	0	0	0.7	0	0	0	0	0	1.7	0.3	0	0	1	0	0	0	0	0	0	0	0.7	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3
Spray irrigation	4.5	2.5	3.7	1.5	4	0.7	0	0	3.3	2	2	0.5	3.7	1.5	1.5	2.5	2.5	2.3	2.7	2.5	3	3.7	3.7	3	3	3	2.5	0	1	4.5	3.7	3	0.7	1.3	3	0	3.3
Incineration	2	2	1.3	2	2	0.7	1.5	1.5	2.7	1.3	0.7	0	2.7	1.5	1.5	1.5	2.5	1.7	2	2	1.3	2	2	2	2	1.5	2	0	1	4	1.7	2.5	0.3	0.3	1	1.5	1.7
Open burning	2.5	2.5	2	2	2.5	0.7	1.5	1.5	4.3	1.7	1	0	3	2	2	1.5	2.5	1.7	2	2	1.7	3	2.7	2	2	1.5	2.5	0	1	4.5	2	3	0.3	0.3	1	2	2.7
Composting	2	2	1.3	2	2	0	0	0	4.7	1.3	1	0.5	2.7	1.5	1.5	1.5	1.5	2.3	1.7	1.5	2.7	2	2	3	1.5	1	2.5	1	1.5	5	1.7	2	0.7	0.3	1	0	2.3
Lagooning	4	3.5	4.3	3	2	0	0	0	5	2.7	2.3	0.5	3.7	2	2.5	2.5	2.5	3.7	4	3	4	5	5	4	3	2.5	4.5	1	1.5	5	5	3.5	0.7	2	4	0	4.7
DISPOSAL																																					
Landfill	3.5	2	3.3	2	3.5	2.3	1	1	4.7	2	1.7	1.5	3.3	1.5	2	2	2	2.3	2.7	1.5	2.3	3	2.7	1	2	2	2	0	0.5	5	4.3	2	0.7	2	3.5	0.5	2.3
Buried	3.5	2	3.3	2	4	2.7	1	1	4.7	2.3	1.7	1.5	3.3	1.5	2	2	2	2.7	3	2	2.3	3.3	3	1	2	2	2.5	0	0.5	5	4.3	2.5	1	2.3	3.5	1	2.7
Open dump	4.5	3	4	2.5	4.5	3	2	2	4.7	2.7	2	2	4.7	2	2.5	3	2.5	3	3.3	2.5	3	4	3.7	2	2.5	2.5	4	0	1	5	4.3	2.5	1.3	2.3	3.5	1	3.7
Plowed into ground	4	2.5	3	2	4.5	1.7	1.5	1.5	5	2	1.3	2.5	3.3	2	2.5	2.5	2.5	3	3.3	3	1.7	3	2.7	3	2.5	2.5	3.5	1	1	5	4	2.5	0.7	2	3	1	2.7
Pit disposal	4	3	4	2.5	5	3.3	2	1.5	5	3.3	2.3	3	3.7	2	2.5	3	3	3.7	4	3	3.3	5	4.7	4	3	2.5	4	1	1	5	5	2.5	1.7	2.7	3.5	1.5	4

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

•Ratings identical for all wastes in category shown

AIR POLLUTION

Scored by: J. Maga, R. L. Chass,
Dr. A. J. Haagen-Smit

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	6 ABANDONED VEHICLES	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	9 SPECIAL WASTES	10 SEWAGE TREAT. RES.	11 WATER TREAT. RES.	12 ASHES	13 HUMAN FECAL MATTER	CROP RESIDUES•	16 BARLEY	19 COTTON LINT	24 RICE	28 WHEAT	49 VEGETABLE CROPS•	71 FRUIT & NUT CROPS•	70 STRAWBERRIES	83 MANURES•	86 COTTON TRASH	87 FRUIT & VEGETABLE	88 POULTRY	89 ANIMAL	90 MILK SOLIDS	91 WINE & SPIRITS	92 VEGETABLE OILS	93 TALLOW	94 COTTON, WOOL, & SILK	95 LUMBER & WOOD PRODS.	96 CHEMICALS	97 PETROLEUM	98 PLASTICS	99 MASONRY WASTES
UNMANAGED	4	0.7	2.3	0.7	4	0	1.3	1.3	2.7	2.7	1.5	2.3	5	2	1.3	1.7	1.3	1.3	3	0	0	3.7	1	1.7	3	3.3	1	1	1.5	2.3	0.3	1.7	3.3	3.7	0	0.7
MANAGED:																																				
STORAGE																																				
Spread	2.7	1.3	2.7	1	4.5	0	1.3	1.3	3	3	2.5	2.3	5	3	2	2.3	2	2	3	0	0	3.7	2	2	3.3	3.3	1	1.3	2	3	0.3	1	3.3	3.7	0	0.7
Piled on ground	2.3	2.3	2.3	0.7	4	0	1	1	2.7	2.7	2	2.3	5	2.5	1.7	2	1.7	1.7	3	0	0	3.7	1.3	1.7	2.3	3.3	1	1	1.5	2.7	0.3	0.7	3.3	3.7	0	0.7
Piled on slabs	2.3	1	2.3	0.7	4	0	1	1	2.7	2.7	2	2.3	5	2.5	1.7	2	1.7	1.7	3	0	0	3.7	1.3	1.7	3	3.3	1	1	1.5	2.7	0.3	0.7	3.3	3.7	0	0.7
Container - open	2.3	0.7	2	0.7	5	0	1	1	2.7	2.3	1.5	2.3	5	2	1.3	1.7	1.3	1.3	3	0	0	3.3	1	1.3	2.7	2.7	1	1	1.5	2.7	0.3	0.7	3.3	3.7	0	0.7
Container - closed	2	0.3	1.3	0	3.5	0	0	0	0.7	1.3	1.5	1	2	0.5	0.3	0.3	0.3	0.3	0	0	0	1.3	0	0.7	1	1	0	0.7	1	0.7	0	0	2	1.7	0	0
TRANSPORT																																				
Open	3.7	2	3	2	4	0	1.7	1.7	1.3	2.7	2	4	5	1.5	1	1.3	1	1	3	1	2	2.3	1.3	1.7	3	3	3	0.7	1	1.3	0.3	1.3	3	3	0	0.7
Closed	1.7	0.3	1	0	0	0	0	0	0.3	0.3	0	0.3	1	0	0	0	0	0	0	0	0	1	0	0.7	0.7	0.7	0	0.3	0.5	0.3	0	0	0.3	0	0	0
PROCESSING																																				
Grinding	3.7	2.3	3.3	3	5	0.3	1.7	1.7	2.7	3.3	3	4.3	5	3	3	3	3	3	5	3	5	4	2.7	2.7	3.7	4.3	5	1	1.5	1.3	2	2.7	4	4	3	2
Spray irrigation	3.7	2.7	3.3	2.7	5	0.3	0.7	0.7	4.3	2.7	2	4	5	4	3	3	3	3	5	2.5	5	4	2	2.7	3.7	4.3	5	1.7	3.5	4	2	1.7	5	4.7	3.5	0.7
Incineration	3.3	2.7	3	2.3	3.5	4	2	2	3.7	3.7	3.5	2.7	5	4	3.7	3.7	3.7	3.7	3	3	3	2.7	3.3	3.7	4.7	4.7	5	2.3	1.5	2.7	2.7	2.7	3	2.7	4	0
Open burning	5	4.3	4.7	4	5	4.7	2.7	2.7	5	3.7	4.5	2.7	5	4.5	4	4	4	4	4	3	3	4.3	4	4.3	4.7	4.7	5	3	1.5	4.3	3.7	3.3	3	4.3	5	0
Composting	1	1	1	0	5	1.7	0	0	2.7	2.3	3.5	1	2.3	1.5	1	1	1	1	0	0	0	2	2	2.3	1.3	2	4	1.3	1.5	0	1	1.7	3	3.3	2.5	0
Lagooning	3.3	2	3	2	5	1.7	1.7	1.7	3.3	2.3	2.5	2	3	2.5	1.7	1.7	1.7	1.7	5	2.5	5	2.3	1.7	3	3.3	3.3	5	2	1.5	1.7	0	1.7	2.3	2.3	2.5	0
DISPOSAL																																				
Landfill	0	0	0	0.3	5	1.7	0	0	1	0.3	0.5	1.7	3	1.5	1	1	1	1	3	1	2	1.7	1.7	1.7	1.7	1.7	5	1.7	0	1	1	1	3.3	3.3	2.5	0
Buried	1	1	1	0.3	2.5	0	0.3	0.3	0.7	1	0.5	0	0.7	1	0.7	0.7	0.7	0.7	0	0	0	0.7	0.7	0.7	1	1.7	0	0.7	0	0.3	0.3	0.3	1.7	1.7	0	0
Open dump	5	3.7	4.7	3.7	5	3.3	3.7	3.7	3.7	3.7	5	2.3	5	5	3.3	3.7	3.3	3.3	5	1	2	4.7	3.7	4	4.3	4.3	5	2.3	1	4	2.7	3.7	2	4	5	0.7
Plowed into ground	1	1	1	0.3	2.5	1.7	0.3	0.3	0.7	1	0.5	1	1	1	0.7	0.7	0.7	0.7	0	0	0	0.7	0.7	0.7	1	1.7	0	0.7	0	0.3	0.3	0.3	1.7	1.7	0	0
Pit disposal	0	0.7	1.3	0.3	5	1.7	0	0	1.3	1.3	1.5	1	2.7	1	0.7	0.7	0.7	0.7	2	1	2	1.7	0.7	1.3	1.3	1.3	2	0.3	0.5	1	0.7	0.7	1.3	1	1	0

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

AIR POLLUTION
(continued)

CONDITIONS / TYPE OF WASTE / WASTE NO.	100 METALS	101 SEEDS	102 TIRES		CONDITIONS
UNMANAGED	0	0.5	0		3
MANAGED:					
STORAGE					
Spread	0	0.5	0		3
Piled on ground	0	0.5	0		3.3
Piled on slabs	0	0.5	0		3.3
Container - open	0	0.5	0		2.7
Container - closed	0	0	0		1.3
TRANSPORT					
Open	0	0.5	0		2
Closed	0	0	0		0.3
PROCESSING					
Grinding	0	3	4		2.3
Spray irrigation	1	2.5	0		2.7
Incineration	0	1	4.7		3
Open burning	0	1	4.7		5
Composting	0	0	1.7		1.3
Lagooning	0	0.5	1.7		1.3
DISPOSAL					
Landfill	0	1.5	1.7		0.3
Buried	0	0	0		0.3
Open dump	0	2	3.3		3.7
Plowed into ground	0	0	0		1
Pit disposal	0	1.5	0.7		0.7

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

*Ratings identical for all wastes in category shown

RODENTS

Scored by: E. Mortenson
E. E. Hogan

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	5 DEAD ANIMALS	6 ABANDONED VEHICLES	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	16-28 FIELD & SEED CROPS*	16 BARLEY	22 OATS	23 ALFALFA	24 RICE	27 SUGAR BEETS	28 WHEAT	36-49 VEGETABLE CROPS*	41 MELONS	56 ALMONDS	FRUIT CROPS*	59 FIGS	65 ORANGES	66 PEACHES	71 WALNUTS	76 CATTLE MANURE	87 FRUIT & VEGETABLE	88 POULTRY	89 ANIMAL	91 WINE & SPIRITS	94 COTTON, WOOL, & SILK	95 LUMBER & WOOD PRODS.	99 MASONRY WASTES	100 METALS	101 SEEDS	102 TIRES	CONDITIONS
UNMANAGED	5	4.5	4.5	5	3	4	4	3	4	4	4	4	4	4	4	4	4.5	3	4	4	4	4.5	5	3	4.5	4	5	5	3	4	3	4.5	5	4
MANAGED:																																		
STORAGE																																		
Spread	4	2	4	2.5	0	0	0	2	3.5	3.5	2	2	2	2	3.5	2	5	2	3.5	3.5	3.5	5	5	2	3.5	2	5	1	1	0	0	2	1	2.5
Piled on ground	5	4.5	5	5	0	5	5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5	4	4.5	4.5	4.5	5	5	4	5	[illegible]	5	5	5	5	4	5	5	5
Piled on slabs	5	4.5	5	5	0	5	5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5	4	4.5	4.5	4.5	5	5	4	5	5	5	5	5	5	4	5	5	5
Container - open	5	2	4.5	5	0	0	0	3	4	4	4	4	4	4	4	4	5	3	4	4	4	5	5	4	5	5	5	0	0	0	0	5	5	4
Container - closed	0.5	0.5	0.5	2.5	0	0	0	0	0	0	0.5	0.5	0.5	0.5	0.5	1.5	0	0	0	0.5	0.5	0	0	0	0	0	1	0	0	0	0	0.5	0	0.5
TRANSPORT																																		
Open	0.5	0.5	0.5	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5
Closed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROCESSING																																		
Grinding	3.5	1	2.5	1.5	0	0	0	2	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	2	3	3	3	4	5	2	3.5	2	5	1	1	0	0	3.5	0	1.5
Spray irrigation	3.5	2	3.5	2.5	0	0	0	2	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	5	2	3.5	3.5	3.5	5	5	2	3.5	2	5	1	1	0	0	3.5	0	1.5
Incineration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.5	2.5	0	0	0	0	0	2.5	5	0	2.5	0	4	0	0	0	0	0	0	0.5
Open burning	3	2	2.5	3.5	0	0	0	3	2	4	2	2	1.5	2	4	4	3	3	3.5	2.5	2.5	3.5	5	3	4	3	4	0	0	0	0	2	0	3
Composting	2	2	2	1.5	0	0	0	0	2	2	1.5	1.5	2	2	2	2	2	0	2	2	2	2	2	0	1	0	4	0	0	0	0	2	0	0.5
Lagooning	0.5	0.5	0.5	1	0	0	0	0	1	1	1	1	2.5	1	2.5	2.5	2.5	0	2.5	2.5	2.5	2.5	4	0	2	0	4	0	0	0	0	1	0	0.5
DISPOSAL																																		
Landfill	1.5	1.5	1.5	1.5	0	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	1	0	0.5	0	3	0	0	0	0	0.5	0	0.5
Buried	0.5	0.5	0.5	0.5	0	0	0	0	0.5	0	0	0	0	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	1	0	0.5	0	1	0	0	0	0	0.5	0	0.5
Open dump	5	5	5	5	3	5	5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5	4	4.5	4.5	4.5	5	5	4	5	5	5	5	5	5	4	5	5	5
Plowed into ground	3	0.5	1.5	2	0	0	0	0	0.5	0	0	0	1.5	0.5	2	2	2	0	0.5	1.5	1.5	3.5	1	1	2	3	2	0	0	0	0	1.5	0	1.5
Pit disposal	2	2	2	2.5	0	0	0	0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0	2.5	2.5	2.5	2.5	5	0	2.5	0	5	0	0	0	0	2.5	0	1

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

*Ratings identical for all wastes in category shown

HUMAN DISEASE

Scored by: Dr. T. J. Hanks, Dr. W. DeFries,
Dr. L. Saylor

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	6 ABANDONED VEHICLES	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	9 SPECIAL WASTES	10 SEWAGE TREAT. RES.*	11 WATER TREAT. RES.*	12 ASHES	13 HUMAN FECAL MATTER
UNMANAGED	4.3	2	3.7	2.7	3.7	1.3	1.7	0.7	4	3.7	2	1	5
MANAGED:													
STORAGE													
Spread	3.7	1	3.3	2.7	3.7	1.3	2	1	3.3	3	1	0	5
Piled on ground	4.3	1.7	4	2.7	3.7	1.3	2.3	1.3	4	3.3	1.5	1	5
Piled on slabs	4.3	1.7	4	2.7	3.7	1.	2	1.3	2.7	3.3	1.5	1	5
Container - open	4.3	1.7	4	2.7	3.7	1.3	2	1.3	3	3.3	1	0	5
Container - closed	2.3	1.7	2.3	1	.3	1.3	1	0.3	3	2.3	0.5	0	5
TRANSPORT													
Open	1.3	.7	1	.7	.7	0	0	0	1.7	2	1	0	4.3
Closed	0.3	0	.3	0	.3	0	0	0	[illegible]	0.3	0.5	0	2.7
PROCESSING													
Grinding	3	2	2.3	1.3	2.3	0.3	1.	0.	3.3	2.3	1.5	0	1.7
Spray irrigation	2	1	2	1	1.7	0.	1	0.	2.	1.3	0.	0	2.7
Incineration	1.3	1.3	1.3	1.3	1.3	0.3	1.3	1.3	2.3	1.3	2	0	2.3
Open burning	3	2	2.3	2.3	3	[illegible]	2.3	2	3	2.7	2	0	2.
Composting	0.7	0.3	.7	.3	1.3	0	0	0	2	0.7	1	0	3
Lagooning	1	0	.3	0	.3	[illegible]	0	0	2	0.3	0.5	0	2.7
DISPOSAL													
Landfill	0.3	0.3	.7	.3	0.3	[illegible]	1.3	0.3	1.7	0.3	0	0	0
Buried	3.3	[illegible]	.3	1.3	.7	[illegible]	1.3	1.3	3	1.7	0.	0	3
Open dump	4.3	.3	4	.3	3.7	1.3	3	2	.7	.3	2	0	5
Plowed into ground	2.7	.3	.3	.3	3.3	0	0	0	3.3	1	.5	[illegible]	3.3
Pit disposal	1.3	0	1.3	0	.3	[illegible]	0	0	1.7	0	0	0	3

CONDITIONS / TYPE OF WASTE / WASTE NO.	16-28 FIELD & SEED CROPS*	45-49 VEGETABLE CROPS*	56-71 FRUIT & NUT CROPS*	76-83 MANURES*	86 COTTON TRASH	87 FRUIT & VEGETABLE	88 POULTRY	89 ANIMAL	90 MILK SOLIDS	91 WINE & SPIRITS	92 VEGETABLE OILS
UNMANAGED	2.7	3.3	3.3	4	1.5	3.7	3.7	3.7	2.3	1.3	1
MANAGED:											
STORAGE											
Spread	2.3	2.3	2.3	3.7	1.5	2.7	3.7	3.7	1.7	1.7	1
Piled on ground	3	3.3	3.3	4	2	3.7	3.7	3.7	2	2	1
Piled on slabs	3	3.3	3.3	4	2	3.7	3.7	3.7	2.3	2	1
Container - open	2.3	3	3	4	2	3.3	3.3	3.3	1.7	1.7	1
Container - closed	1	1.7	1.7	3	1	1.7	2.7	2.7	2	1.3	1
TRANSPORT											
Open	0.7	1	1	2	0.5	1	2	2	2	1	2
Closed	0	0.3	0.3	1	0	0.3	1	1.7	1	0.3	0
PROCESSING											
Grinding	2	2	2	2.	1.5	2.3	2	2	0.7	1	0
Spray irrigation	1	1	1	3	0.5	0.	2.7	2.7	1.7	0.	0
Incineration	1.3	1.	1.3	1.3	1	1.3	1.3	1.3	1.	1.3	2
Open burning	1.7	1.7	1.7	1.7	1.5	1.7	2	2	1.3	1.3	3
Composting	0.3	0.3	0.3	1.3	0.5	0.3	1.3	1.3	1.3	0.	0
Lagooning	0.3	0.3	0.3	1	0	0.3	0.	1	1	0.3	0
DISPOSAL											
Landfill	0	0	0	0	0	0	0	0	0	0	0
Buried	0.7	1.7	1.7	1.3	0.5	1.7	1.3	1.3	1	1	2
Open dump	2.3	3	3	4	2.5	3.7	3.7	3.7	2.3	2	4
Plowed into ground	1	1.7	1.7	2	1.5	1.7	2	2	1.7	1	4
Pit disposal	0.3	0.3	0.3	2	0	0.7	1.7	1.7	1.3	.3	0

CONDITIONS / TYPE OF WASTE / WASTE NO.	93 TALLOW	94 COTTON, WOOL, & SILK	95 LUMBER & WOOD PRODS.	96 CHEMICALS	97 PETROLEUM	98 PLASTICS	99 MASONRY WASTES	100 METALS	101 SEEDS	102 TIRES	CONDITIONS
UNMANAGED	3.7	0.5	0	3.7	2	2	0.7	5	3.5	4	5
MANAGED:											
STORAGE											
Spread	3	0	0	2.7	1.3	0	0.3	5	3	4	4
Piled on ground	3.7	0	0	3.	1.3	1	0.3	5	3.5	5	4.7
Piled on slabs	3.7	0	0	3	1.7	2	0.3	5	3.5	5	4.3
Container - open	3.3	0.5	1	3	2	2	0.3	5	3.5	5	3.7
Container - closed	2.7	0.5	1	3	0.7	0	0.3	5	3	1	1.3
TRANSPORT											
Open	2.3	0	0	2	1.7	1	0.3	5	2.5	0	2.3
Closed	1	0	0	1	0	[illegible]	0	3	1.5	0	0.7
PROCESSING											
Grinding	2	1.	3	2	2.	5	2	0	1	0	2.7
Spray irrigation	2.	0	0	2.7	2.7	[illegible]	0.3	5	3	0	1.7
Incineration	1.	2	2	2.3	2.3	3	0	5	2.5	3	1
Open burning	2.	3	4	3.7	2	5	0.3	5	2.5	4	2
Composting	1.3	0	0	1.	0.	0	0	5	2.5	0	0.3
Lagooning	1	0	0	2	0.	0	0	5	2.5	0	0.7
DISPOSAL											
Landfill	0	0	0	1.7	1.	[illegible]	1	5	2.5	1	0.3
Buried	1.7	1	2	2	2	4	1.7	5	2.5	2	1.7
Open dump	3.7	2.5	[illegible]	3.7	2.7	5	2	5	3.5	3	4.3
Plowed into ground	2	0	0	2	2	0	0	5	2.5	0	
Pit disposal	1.3	0	0	1.3	1.	0	[illegible]	5	2.5	0	1

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

*Ratings identical for all wastes in category shown

ANIMAL DISEASE

Scored by: Dr. J. Nehay, R. Glim, L. Dowler

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	9 SPECIAL WASTES	13 HUMAN FECAL MATTER	76-83 MANURES*	88 POULTRY	89 ANIMAL	96 CHEMICALS	97 PETROLEUM	101 SEEDS	CONDITIONS
UNMANAGED	4.5	3	4.5	5	5	2	3.5	3.5	4	3	3	5
MANAGED:												
STORAGE												
Spread	1.5	3	4.5	5	5	0.5	4	4	4	2.5	3.5	3
Piled on ground	3.5	3	4.5	5	5	1	4.5	4.5	4	3.5	4	4
Piled on slabs	3	2	4.5	5	5	0.5	4.5	4.5	4	3.5	4	3.5
Container - open	2.5	0	4	5	5	0	3.5	4.5	4	2.5	4	2
Container - closed	0	0	0	0	0	0	0	0	0	0	0	0
TRANSPORT												
Open	1	1	1	2.5	3	0.5	1	1	2.5	2	2.5	1
Closed	0	0	0	0	0	0	0	0	0	0	0	0
PROCESSING												
Grinding	3	3	4.5	5	5	2	3	3	4.5	3	3.5	3.5
Spray irrigation	1	0	1.5	5	5	1.5	3.5	3.5	4.5	4	4	3
Incineration	0	0	0	5	0	0	0	0	4.5	1	3	1.5
Open burning	2	0	2.5	5	5	1.5	3	3	4.5	2.5	2.5	2
Composting	1	1	2.5	5	5	0.5	2	2	4.5	3	3	3
Lagooning	1.5	3	2.5	5	4	0.5	2	2	4.5	4	1.5	2.5
DISPOSAL												
Landfill	1	1	4.5	4.5	5	0	3	3	4.5	2.5	2.5	3
Buried	0	0	3	3.5	1	0	2	2	4.5	2.5	2	2.5
Open dump	4.5	2	4.5	5	5	1	4.5	4.5	4	3.5	4	4.5
Plowed into ground	1	2	4	5	4	0.5	2.5	2.5	4.5	2.5	2	2.5
Pit disposal	0	0	1.5	2.5	5	0.5	0.5	0.5	2	2.5	1.5	2

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

*Ratings identical for all wastes in category shown

OTHER INSECTS

Scored by: E. Mortenson, H. Magy

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	6 ABANDONED VEHICLES	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	9 SPECIAL WASTES	10 SEWAGE TREAT. RES.	13 HUMAN FECAL MATTER	49 VEGETABLE CROPS*	57 APRICOTS	59 FIGS	61 GRAPES	63 NECTARINES
UNMANAGED	5	4	4.5	3	4.5	3	3	3	3.5	3	5	2	4	3	3	4
MANAGED:																
STORAGE																
Spread	3	3.5	3	1	5	3	2	2	2.5	0.5	4	1	1	1	0	1
Piled on ground	5	4	4.5	3	4.5	3	3	3	3.5	3	5	1	4	3	3	4
Piled on slabs	5	4	4.5	3	4.5	3	3	3	3.5	3	5	2	4	3	3	4
Container - open	5	3.5	4.5	3	4.5	3	3	3	3.5	3	5	5	4	3	3	4
Container - closed	5	2.5	4.5	2	4.5	2.5	2	2	3	1	4	2	0	0	0	0
TRANSPORT																
Open	5	2.5	5	3	3.5	1	3	3	1.5	1.5	5	5	2	1	2	2
Closed	2.5	2.5	2.5	2	2.5	0.5	2	2	1	1	3.5	2	0	0	0	0
PROCESSING																
Grinding	3.5	3.5	3.5	3	5	1.5	1	0	2	1.5	3.5	2	1	1	0	1
Spray irrigation	3.5	3.5	3.5	3	5	1.5	0	0	1	0	4	3	1	1	0	1
Incineration	2.5	2	2.5	1	2.5	0.5	1	1	1	2	2.5	3	0	0	0	0
Open burning	3.5	3	3	1	4.5	3	1	1	2.5	0.5	4.5	3	3	2	2	3
Composting	0.5	0.5	0.5	1	2.5	0.5	0	0	0	0.5	2.5	1	0	0	0	0
Lagooning	2.5	2.5	2.5	3	2.5	0.5	0	0	1.5	1.5	2.5	3	0	0	0	0
DISPOSAL																
Landfill	1.5	1.5	1.5	2	1.5	0	0	0	1.5	0.5	2.5	2	0	0	0	0
Buried	1.5	1.5	1.5	2	1.5	0	0	0	1.5	0.5	2.5	2	0	0	0	0
Open dump	5	4	4.5	3	4.5	4	3	3	4	3	5	5	4	3	3	4
Plowed into ground	3	3.5	3	3	2.5	2.5	3	3	2	1.5	5	2	1	0	0	0
Pit disposal	3.5	2.5	3.5	3	3.5	2.5	3	3	2	2.5	5	2	0	0	0	0

CONDITIONS / TYPE OF WASTE / WASTE NO.	66 PEACHES	68 PLUMS	76 CATTLE MANURE	77 SHEEP MANURE	78 HOG MANURE	79 HORSE & MULES MANURE	80 CHICKEN MANURE	81 TURKEY MANURE	82 PIGEON MANURE	83 RABBIT MANURE	87 FRUIT & VEGETABLE*	88 POULTRY	89 ANIMAL	90 MILK SOLIDS	91 WINE & SPIRITS	93 TALLOW*	99 MASONRY WASTES	100 METALS	102 TIRES	CONDITIONS
UNMANAGED	5	5	2	1	3.5	2	3	2	2	2	4.5	5	5	3	3	4	3	3	4	4
MANAGED:																				
STORAGE																				
Spread	1	1	1	1	1	1	1	0	1	1	3.5	5	5	3	1	4	1	1	1.5	3
Piled on ground	5	5	2	1	3.5	2	3	2	2	2	4.5	5	5	3	2	4	3	3	4	5
Piled on slabs	5	5	2	1	3.5	2	3	2	2	2	4.5	5	5	3	2	4	3	3	4	4.5
Container - open	5	5	3	3	3.5	2	3	2	2	2	4.5	5	5	3	3	4	2	3	4	4
Container - closed	0	0	2	2	1.5	2	2	2	1	2	1	5	5	0	3	2.5	1	2	1	2.5
TRANSPORT																				
Open	4	2	3	3	2	3	3	2	2	3	3.5	5	5	0	3	2.5	2	3	1.5	3.5
Closed	0	0	2	2	1.5	2	2	2	2	2	1	5	5	0	3	2.5	1	2	0.5	1.5
PROCESSING																				
Grinding	1	1	1	1	1	1	1	1	1	1	4.5	5	5	3	3	4	0	0	0	2
Spray irrigation	1	1	2	2	2	2	3	2	2	3	4.5	5	5	3	5	3.5	0	0	0	2
Incineration	0	0	3	1	2	1	2	1	1	2	1.5	5	5	0	3	2.5	1	1	0	0.5
Open burning	5	4	3	1	2	1	2	2	2	2	3	5	5	2	3	4	1	1	1.5	3.5
Composting	0	0	0	0	1	0	1	0	0	1	0.5	5	5	0	2	2.5	0	0	0	0.5
Lagooning	0	0	3	3	2	3	3	3	3	3	1.5	5	5	0	3	2.5	0	0	0	1
DISPOSAL																				
Landfill	0	0	1	1	1	1	1	1	1	1	1	2	1	0	1	1	0	0	0	0.5
Buried	0	0	1	1	1	1	1	1	1	1	1	2	1	0	1	1	0	0	0	1.5
Open dump	5	5	5	3	4	3	5	2	3	3	4.5	5	5	3	5	4	3	3	4	4.5
Plowed into ground	1	1	3	1	1.5	2	3	1	1	3	2.5	5	5	0	3	2.5	3	3	1.5	2
Pit disposal	0	0	3	1	1.5	2	3	1	1	3	2.5	5	5	2	3	2.5	3	3	4	3

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

*Ratings identical for all wastes in category shown

SAFETY HAZARDS

Scored by: E. Wrought, C. Denier, C. Berry

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	6 ABANDONED VEHICLES	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	9 SPECIAL WASTES	10 SEWAGE TREAT. RES.	11 WATER TREAT. RES.	12 ASHES	13 HUMAN FECAL MATTER	14-28 FIELD & SEED CROPS*	29-49 VEGETABLE CROPS*	50-71 FRUIT & NUT CROPS*	72-85 MANURES*	86 COTTON TRASH	87 FRUIT & VEGETABLE	88 POULTRY	89 ANIMAL	90 MILK SOLIDS	91 WINE & SPIRITS	92 VEGETABLE OILS	93 TALLOW	94 COTTON, WOOL, & SILK	95 LUMBER & WOOD PRODS.	96 CHEMICALS	97 PETROLEUM	98 PLASTICS	99 MASONRY WASTES	100 METALS	101 SEEDS	102 TIRES	CONDITIONS
UNMANAGED	2.5	4	5	4.5	5	4	4.7	4.7	3.7	4	3	4	5	2	2.7	3.7	3	3.5	4	4	4	4	3.5	4	4	4	4.7	5	4	5	3.3	4	5	5	4.7
MANAGED:																																			
STORAGE																																			
Spread	2.5	4	5	4	5	5	4.3	4.3	3.7	3	1	4	5	1.7	2	3.3	1.7	2.5	4	4	4	3.5	2.5	4	3.5	4	4.7	5	3	5	3.7	4	5	5	4.3
Piled on ground	2.5	3.7	5	3.5	5	3	4	4	3.3	3	2	4	5	1.7	2.3	3.3	2	2.5	4	4	4	4	3	4	3.5	3	4	5	4	2	2.7	4	4	0	3.7
Piled on slabs	2.5	3	4	2.5	5	2	3.7	3.7	3.3	4	2	4	5	1.7	2.3	3.3	2	2.5	4	4	4	4	3	4	3.5	3	4	5	4	2	2.7	4.7	4	0	3.3
Container - open	3	3	2	1.5	5	0	3	3	3	1	1	2	5	1.3	1.7	2	1.7	2.5	2.5	3.5	3.5	3.5	2.5	2.5	3	2	3	5	3	2	1.7	4.7	4	0	2
Container - closed	1.5	1	0	0	0	0	1.7	1.7	1	0	0	0	0	1	1	1.3	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.7	0	0	0	1.7	1.7	0	0	0.7
TRANSPORT																																			
Open	2.5	2.3	3.5	3	4	1	1.3	1.3	2.3	3	2	4.5	5	2.3	1.3	1.7	2	2	1.5	1	1	1	1	1	1	1.5	3	5	4	2	1	3	5	0	1.7
Closed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROCESSING																																			
Grinding	1.5	2	1.5	1.5	2	3	2.3	2.3	1.3	2	2	1.5	4	1	0.7	1.3	0.7	2.5	2.5	2.5	2.5	2	2.5	2	2.5	3	2.3	3	2	3	1.3	2.3	3	3	1.3
Spray irrigation	1	1.7	1	1	2	1	2	2	1	2	2	1	4	1	0.7	1.3	0.7	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.3	3	2	2	1	2.3	4	2	1.3
Incineration	1.5	1.3	3	2	3	2	1.3	1.3	1.3	2	2	1	3	1	1.3	1.3	1.3	1.5	1	1	1	1	1	1	1	1	1	3	3	3	1.3	1.7	3	3	1.3
Open burning	2.5	4	5	4	5	5	4.3	4.3	3.7	5	2	2.5	5	3.3	2.3	3.7	2.7	4	4	4	4	4	4	4	4	4	4.7	5	5	5	2	2	5	5	4.3
Composting	1.5	1	1.5	1.5	4	4	1	1	1	1	1	0.5	4	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	0.3	5	3	4	1	1.3	4	4	0.7
Lagooning	1.5	1	1.5	1.5	3	4	1	1	1	1	1	0.5	4	1	0.7	0.7	0.7	1.5	1	1	1	1	0.5	1	1	1.5	1	5	5	5	0.7	1.7	5	3	1
DISPOSAL																																			
Landfill	1.5	2	1.5	1.5	4	4	2.3	2.3	1.7	1	0	1	4	1.3	1	1.7	1	3	3	3.5	3.5	3	2.5	2.5	2.5	2.5	2.3	5	4	2	1.3	2	4	3	1
Buried	2	2.3	2	2	3	4	2.3	2.3	1.7	2	0	1	4	1.3	1.3	2	1	3	3	3	3	3.5	3	3	3	2.5	2.7	3	5	2	1.3	1.7	4	3	1.3
Open dump	2.5	3.3	4.5	3.5	5	5	4.3	4.3	3	5	2	3.5	5	2.7	2.3	3	2	4	4	4	4	4	4	4	4	4	5	5	5	5	2.7	3.7	5	5	3.7
Plowed into ground	1.5	2	1.5	1.5	4	4	2.7	2.7	2	2	0	1	5	1	1	1.7	0.7	2.5	2.5	3	3	2.5	2.5	2.5	3	3	2.3	5	4	3	1.3	2.3	4	3	1.7
Pit disposal	2	2.3	4	2	5	4	3.3	3.3	2	3	2	3	3	1.3	1.3	2	1	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3	5	2	3	3	4	2	2.3

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

*Ratings identical for all wastes in category shown

ODOR

Scored by: P. Maier, C. Jones, W. Slipe

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	6 ABANDONED VEHICLES	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	9 SPECIAL WASTES	10 SEWAGE TREAT. RES.	11 WATER TREAT. RES.	12 ASHES	13 HUMAN FECAL MATTER	16-49 VEGETABLE CROPS*	37 CABBAGE	41 MELONS	48 TOMATOES	FRUITS*	63 NECTARINES	66 PEACHES	68 PLUMS	76 CATTLE MANURE	77 SHEEP MANURE	78 HOGS MANURE	79 HORSES MANURE	80 CHICKENS MANURE	81 TURKEYS MANURE	82 PIGEONS MANURE	83 RABBITS MANURE	86 COTTON TRASH	87 FRUIT & VEGETABLES	88 POULTRY	89 ANIMAL	90 MILK SOLIDS	91 WINE & SPIRITS	92 VEGETABLE OILS	93 TALLOW
UNMANAGED	4.7	3	4	2.5	5	1	1	1	3.3	5	4	1	5	3	3.5	3.5	3.5	2	2.5	3	2.5	4.5	3.5	4.5	3.5	4	4	3	3.5	4	3.5	5	5	4	4	3	4.5
MANAGED:																																					
STORAGE																																					
Spread	3.7	3	3	2	5	1	1	1	3	4	3	1	5	1	1.5	1.5	1.5	1	1	2	1	3	2	3	2	2	2	2	2	2	2	4	4	2	2	1	2
Piled on ground	4.7	3	3.7	2.5	5	1	1	1	3.7	4.7	3	1	5	3	4	4	4	2	3	3.5	3	4.5	4	4.5	4	4.5	4.5	4	4	4	4.5	5	5	4	4	3.5	4.5
Piled on slabs	4.7	3	4	2.5	5	1	1	1	3.7	4.7	3	1	5	3	4	4	4	2	3	3.5	3	4.5	4	4.5	4	4.5	4.5	4	4	4	4.5	5	5	4	4	4	4.5
Container - open	3.2	1.5	3.7	2	5	1	1	1	3.7	4.3	3	1	5	2	3.5	3.5	3.5	1	3	3	3	4	4	4	3.5	4	4	3.5	4	3	4	4.5	4.5	4	4	4	4
Container - closed	1.7	1	1.3	0.5	5	1	1	1	2.7	3	2	1	4.3	2	2.5	2.5	2.5	1	2	2	2	3	2.5	4	2.5	3	3	2.5	2.5	2	2.5	3.5	3.5	3	2.5	1.5	2.5
TRANSPORT																																					
Open	3.3	2	2.7	1.5	5	1	1	1	3	3.7	2	1	4.7	3	3	3	3	2	2	2.5	2	4	3	3.5	2.5	3	3	2.5	2.5	4	2.5	4	4	4	3	2	4
Closed	1.3	1	1.3	0.5	5	1	1	1	2.3	3	3	1	4	2	1.5	1.5	1.5	1	1	1	1	2.5	2	4	2	2	2	2	2	2	1.5	2.5	3	3	2	1	2
PROCESSING																																					
Grinding	3.3	1	1.3	0.5	5	1	1	1	2.7	3.3	2	1	4.3	1	1.5	1.5	2	1	1	1.5	1	4	3.5	4	3.5	3.5	3.5	3	3.5	4	3	4	4	4	3	2.5	3.5
Spray irrigation	4	2.5	2.3	1.5	5	0	0.5	0	1.7	3.3	2	0	4.3	3	2.5	2.5	3	2	1.5	2	1.5	3.5	3.5	4	3.5	3.5	3.5	3	3.5	4	3	4	4	1	3	2.5	4.5
Incineration	3.7	2	2.7	3	5	3	2	3	3.7	3	2	0	4.7	2	2.5	3.5	3.5	1	3	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	1	3	3	3	1	3.5	3	3
Open burning	5	4.5	4.3	3.5	5	4	3	4	4.3	4.7	3	0	4.7	1	3	3	3	1	3	3	3	5	5	5	5	5	5	5	5	5	5	5	5	1	5	4.5	4.5
Composting	3	2	3.3	1.5	3.3	0	1.5	0	2.3	2.7	3	0	3.3	1	1.5	1.5	1.5	1	1.5	1.5	1.5	2	2	1.5	1.5	2	1.5	1.5	1.5	1	2	2.5	2	1	2	1	4
Lagooning	4	3.5	2.7	2	3.3	0	0	0	1.7	3.3	3	0	4.7	0	2.5	2.5	2.5	0	2.5	2.5	2.5	3	2.5	3	3	3	3	3	3	2	3.5	4.5	4.5	4	3	2.5	3
DISPOSAL																																					
Landfill	3	1	1.3	0.5	4.7	1	1	1	1.7	1.3	1	1	4.7	1	1.5	1.5	2	1	1	1.5	1	2.5	2.5	2.5	2.5	2	2	2	2	0	2	2.5	2.5	1	1.5	1	2
Buried	3.3	1.5	2.7	1.5	5	1	1	1	2.7	3	2	1	4.3	1	2	2	2	1	2	1.5	1.5	4.5	3.5	4.5	3.5	4	4	3	3.5	1	2	3.5	3.5	1	2.5	1	2.5
Open dump	4.7	2.5	4	2	5	1	1	1	3.3	4.3	3	1	5	3	3.5	3.5	3.5	2	2.5	3	2.5	4.5	3.5	4.5	3.5	4	4	3	3	4	3.5	5	5	4	4	3	4.5
Plowed into ground	4	1.5	1.7	1	3.3	1	1	1	2.7	2.7	2	1	4	1	2	2	3	1	1.5	3	1.5	4	3	4	3	3.5	3.5	3	3	1	2	3.5	3.5	1	2	1	4.5
Pit disposal	3.7	1.5	2	1	5	1	1	1	2.7	2.3	2	1	4.3	1	1	1	1	1	1	1	1	3.5	3	4.5	3	3	3	3	3	1	1.5	3.5	3.5	1	1.5	0.5	1.5

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

ODOR
(continued)

CONDITIONS \ TYPE OF WASTE / WASTE NO.	94 COTTON, WOOL, & SILK	96 CHEMICALS	97 PETROLEUM	98 PLASTICS	99 MASONRY WASTES	100 METALS	101 SEEDS	102 TIRES	CONDITIONS
UNMANAGED	1	5	4.5	1	1	2	2	0.3	4.3
MANAGED:									
STORAGE									
Spread	1	5	4.5	1	1	1	0	0.3	3
Piled on ground	1	5	4.5	1	1	2	2	0.3	4
Piled on slabs	1	5	4.5	1	1	2	2	0.3	4
Container - open	1	2	2.5	1	1	1	1	0.3	3.3
Container - closed	1	2	2	1	0	0	1	0.3	2
TRANSPORT									
Open	1	4	3	1	1	1	1	0.3	3
Closed	1	2	1	1	1	1	1	0.3	1
PROCESSING									
Grinding	1	5	3	1	1	2	1	2	3.7
Spray irrigation	1	5	3	1	1	2	2	1.3	3.3
Incineration	1	2	3	2	0	0	1	4.3	2
Open burning	5	5	5	5	0	2	4	5	5
Composting	1	2	1	1	1	1	1	0.7	2
Lagooning	1	5	4	0	0	0	2	0	3.7
DISPOSAL									
Landfill	0	3	2.5	0	0	0	0	0.3	2
Buried	0	4	4	0	0	0	0	1.3	3
Open dump	1	5	4.5	1	1	2	2	0.3	4.3
Plowed into ground	0	4	4	0	0	0	0	0.3	3
Pit disposal	0	4	3	0	0	0	0	0.3	2

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

•Ratings identical for all wastes
in category shown

PLANT DISEASE & CROP DAMAGE

Scored by: Dr. J. Harvey, J. Kalstrom,
Dr. L. Leach, Dr. Hewitt, M. Covey

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	10 SEWAGE TREAT. RES.	16-28 FIELD & SEED CROPS•	19 COTTON LINT	20 COTTON SEED	36-49 VEGETABLE CROPS•	48 TOMATOES	56-71 FRUIT & NUT CROPS•	56 ALMONDS	57 APRICOTS	59 FIGS	61 GRAPES	63 NECTARINES	65 ORANGES	66 PEACHES	68 PLUMS	70 STRAWBERRIES	76-83 MANURES•	86 COTTON TRASH	87 FRUIT & VEGETABLE	91 WINE & SPIRITS	95 LUMBER & WOOD PRODS.	96 CHEMICALS	97 PETROLEUM	98 PLASTICS	99 MASONRY WASTES	101 SEEDS	CONDITIONS
UNMANAGED	5	5	5	4	3	3	5	5	3.5	3.5	5	5	4	3	3	3	3	3.7	4	3.7	3	4	5	4	2.7	3	3	3.7	2.5	1	2	3	4.7
MANAGED:																																	
STORAGE																																	
Spread	5	5	5	4	3	3	5	5	3	3	5	4.5	4	3	3	3.5	3.5	3.3	3.5	3.3	3	3.5	5	2.5	4.3	2.5	3	3.7	4.5	1	2	3.5	4
Piled on ground	5	5	5	4	3	3	5	5	3	3	5	5	4	3	3	3	3	3.7	4	3.7	3	4	5	2.5	3.7	2.5	3	2.7	3	2	2.5	3.5	4.3
Piled on slabs	5	5	5	4	2	2	5	4	2.5	2.5	4	4.5	4	3	3	3	3	3.7	4	3.7	3	4	3	1	3.7	0.5	3	1	1.5	2	1	3	4
Container - open	3	3	3	1	1	1	3	1	1	1	1	3	5	3.5	3.5	3.5	3.5	4	4.5	4	3.3	4.5	2	0.5	3	0.5	0	0.3	0.5	1	0.5	1.5	3
Container - closed	0	0	0	0	0	0	0	0	0.5	0.5	0	2.5	0	1	1	1	1	2.3	2	2.3	1.7	2	0	0	2	0	0	0.3	0.5	1	0.5	0.5	1.7
TRANSPORT																																	
Open	3	2	3	1	1	1	3	1	0.5	0.5	1	3	5	2.5	2.5	3.5	3.5	3.3	4.5	3.3	2.7	4.5	2	3	1.7	0.5	1	0.7	1	2	1	2	1.3
Closed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROCESSING																																	
Grinding	5	5	4	3	3	3	5	5	2.5	2.5	5	4.5	4	2	2	3	3	2	3.5	2	2	3.5	5	2.5	2	2.5	3	5	4.5	1	3	3.5	3.3
Spray irrigation	5	5	4	3	3	3	5	5	2.5	2.5	5	4.5	4	2	2	3	3	2	3.5	2	2	3.5	5	2.5	2	2.5	3	5	4.5	1	3	3.5	3.3
Incineration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.3	2	0	0	0	0.7
Open burning	0	0	0	0	0	0	0	0	0	0	0	2.5	0	0	0	1	1	1.7	2	1.7	1	2	0	0	0.7	0	0	3.3	2.5	2	1	1	1.7
Composting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.7	0	0	0	0	0.7
Lagooning	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0.5	0.5	0.3	0.5	0.3	0.3	0.5	0	0	0.3	0	0	3.3	2.5	0	0	0.5	1.3
DISPOSAL																																	
Landfill	5	5	5	4	3	3	5	5	2.5	2.5	5	2.5	4	2	2	2	2	1.3	2	1.3	1.3	2	5	2.5	1.3	2.5	3	5	2	0	1.5	1.5	2.3
Buried	5	4	3	2	1	2	5	1	0.5	0.5	1	1	1	0.5	0.5	1	1	0.7	1	0.7	0.7	1	1	0.5	0.7	0.5	1	3.3	0	0	1.5	0.5	1.7
Open dump	4	4	3	3	3	3	4	5	3	3	5	5	4	2.5	2.5	3	3	3.3	4	3.3	2.7	4	5	2.5	2.3	3	3	3.7	2.5	1	2	2	3
Plowed into ground	5	5	5	4	3	3	5	5	2.5	2.5	5	2.5	4	2	2	2	2	1.7	2	1.7	1.7	2	5	2.5	1.7	2.5	3	5	4.5	1	2.5	4	3
Pit disposal	5	4	3	2	1	2	5	1	0.5	0.5	1	0.5	1	0.5	0.5	0.5	0.5	0.3	0.5	0.3	0.3	0.5	1	0.5	0.3	0.5	1	1.7	0	0	1.5	0.5	1

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

*Ratings identical for all wastes in category shown

LAND POLLUTION

Scored by: C. Finch, W. Norman, R. Bergstrom

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	6 ABANDONED VEHICLES	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	9 SPECIAL WASTES	10 SEWAGE TREAT. RES.	11 WATER TREAT. RES.	12 ASHES	13 HUMAN FECAL MATTER	16-[illegible] FIELD & SEED CROPS*	[illegible] VEGETABLE CROPS*	[illegible] FRUIT & NUT CROPS*	[illegible]-83 MANURES*
UNMANAGED	5	4.3	5	4	4.3	4.7	4.7	4.7	5	4.7	4.7	4.3	5	2.3	3.3	2.3	4.3
MANAGED:																	
STORAGE																	
Spread	4.7	4.3	4.7	4	3.7	4.7	4.7	4.7	5	3.7	3.3	3.3	4	1.7	2.3	2	3.3
Piled on ground	5	4	5	4	4	4.3	4.3	4.3	5	4	4	3.3	4	2	3	2	3.7
Piled on slabs	5	4	5	4	3.3	4.3	4.3	4.3	4.7	3.7	3.7	2.7	3.7	2	2.7	2	3.7
Container - open	4.3	3.7	4.3	3.7	3.3	3.3	3.7	3.7	4.3	3.7	3.3	2	4.3	1.7	2	2	3.3
Container - closed	3.7	4	3.7	4	3	3.3	3.7	3.7	3.7	3.3	3	1.3	4	1.7	2.3	2	3.7
TRANSPORT																	
Open	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Closed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROCESSING																	
Grinding	3.7	3.3	3.7	3	2.7	3.3	3.7	3.7	5	3	3	3	4.3	1.7	2.3	1.7	3.3
Spray irrigation	3.3	3.7	3.3	3.3	3	4.7	5	5	4.3	2.7	2.7	2	4.3	2	2.7	2	3
Incineration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Open burning	4.7	4.3	4.7	4.3	4	4.7	4.3	4.3	5	4	4.3	4.3	4	2.3	3.3	2.3	4.7
Composting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lagooning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DISPOSAL																	
Landfill	4	3.7	4	3.7	3	4	4.3	4.3	4.7	3.3	3.7	3	3.7	2	3	2	4
Buried	4.3	4	4.3	4	3.3	4	4.3	4.3	4.7	3.7	4	3	3.7	2	3	2	4
Open dump	4.7	4.7	4.7	4.7	4	4.3	4.3	4.3	5	4	4.3	3.7	4	2.7	3.7	2.7	4.7
Plowed into ground	4.7	4.7	4.7	4.3	3.7	4.7	5	5	5	3.7	3.7	3.7	4.3	1.7	2.3	1.7	3.7
Pit disposal	4.3	4	4.3	4	3.3	4.7	4.7	4.7	4.7	3.7	4	3.3	3.7	2	3	2	4

CONDITIONS / TYPE OF WASTE / WASTE NO.	86 COTTON TRASH	87 FRUIT & VEGETABLE	88 POULTRY	89 ANIMAL	90 MILK SOLIDS	91 WINE & SPIRITS	92 VEGETABLE OILS	93 TALLOW	94 COTTON, WOOL, & SILK	95 LUMBER & WOOD PRODS.	96 CHEMICALS	97 PETROLEUM	98 PLASTICS	99 MASONRY WASTES	100 METALS	101 SEEDS	102 TIRES	CONDITIONS
UNMANAGED	2.7	3	4.7	4.7	3	4.7	4.7	4.3	3.3	2.7	5	5	4.7	4.7	5	3.3	4.3	5
MANAGED:																		
STORAGE																		
Spread	2	1.7	4.3	4.7	2.7	3.3	4	3.3	3.3	2	5	5	4.7	4.7	4.3	3	4	4.7
Piled on ground	2.3	2.3	4.3	4.7	2.7	3.7	4.3	4	3.3	2	5	5	4.3	4.7	4.7	2.7	3.7	4.7
Piled on slabs	2.3	2.3	3.7	4	2.7	3.3	4	4	3	1.7	3.7	3.7	3.3	4	4.3	3	3.7	4.3
Container - open	2.3	2.3	3.7	3.7	2.7	3	4	3.7	2	1.7	3	2.7	2	2.3	3.3	2	2.3	3.3
Container - closed	2.3	2.3	3.3	3.3	2.3	3	3.7	3.7	2	1.7	2.3	2.3	2	2.3	3.3	1.7	2	3.3
TRANSPORT																		
Open	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Closed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROCESSING																		
Grinding	2	2	3.7	4.3	2.7	3.3	4.3	3.3	2.3	2.3	5	5	4	3.7	3.7	2.3	2.7	3.3
Spray irrigation	2.3	2	3.7	4.3	2.7	3.3	4.3	3.3	2.7	2.7	5	4.7	5	4	4.7	3	3.7	3
Incineration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Open burning	2.7	3	5	4.3	3.3	4	5	4	3.3	2.7	5	5	5	5	5	3	3.7	4
Composting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lagooning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DISPOSAL																		
Landfill	2.3	2.3	[illegible]	3.7	2.3	3.3	4.3	3.3	3.3	2.3	4.3	4.3	4.3	4.3	4.3	2.7	4	2.3
Buried	2.3	2.3	4.3	4	2.7	3.7	4.3	3.7	3	2.7	4.7	4.7	4.7	4.7	4.7	2.7	4	3.3
Open dump	3	3	5	4.7	3.3	4	5	4	3.3	3.3	4.7	4.7	4.7	4.7	4.7	3.3	3.7	4.3
Plowed into ground	2.3	2.3	4.7	4.3	2.7	3.3	4.3	3	3	3	5	4.7	5	4.3	4.3	3	4.3	4.7
Pit disposal	2.3	2.3	4.3	4	2.7	3.7	4.3	3.3	3	2.7	4.7	4.7	4.7	4.7	4.7	2.7	3.7	3.3

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

•Ratings identical for all wastes
in category shown

UNSIGHTLINESS

Scored by: H. Tokmakian, P. Maier, H. DuPertuis

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	6 ABANDONED VEHICLES	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	9 SPECIAL WASTES	10 SEWAGE TREAT. RES.	11 WATER TREAT. RES.	12 ASHES	13 HUMAN FECAL MATTER	16-28 FIELD & SEED CROPS•	19 COTTON LINT	36-49 VEGETABLE CROPS•	37 CABBAGE	41 MELONS	46 SQUASH	48 TOMATOES	FRUIT CROPS•	60 GRAPEFRUIT	62 LEMONS	65 ORANGES	66 PEACHES	ANIMAL MANURES•	POULTRY MANURES•	86 COTTON TRASH	87 FRUIT & VEGETABLE	88 POULTRY	89 ANIMAL	91 WINE & SPIRITS	92 VEGETABLE OILS	93 TALLOW	94 COTTON, WOOL, & SILK	95 LUMBER & WOOD PRODS.	96 CHEMICALS
UNMANAGED	5	4.3	5	3.7	5	4.3	3.7	3.3	4	3.3	2.3	3	5	4	3.5	3	3	3	3	3.3	3	3	2.5	3	3	3.7	4.7	2.7	2.7	5	5	2.7	2.5	3.3	3	2.3	3.5
MANAGED:																																					
STORAGE																																					
Spread	4.3	4.3	4.7	3.7	5	3.7	4	3.3	4.7	2.3	1.7	2.7	4.7	4	3.5	5	4	3.7	4	3.7	5	4	3.5	4	4	2.3	2.7	3.3	3.3	4.7	4.7	3	2	4	2.3	1.3	2.5
Piled on ground	4	3.7	4.3	3.3	4.3	3.7	2.7	2.3	4.3	2	2	3	4.3	1	1.5	4	3.5	3.3	3.5	3.3	5	4.5	4.5	4.5	4.5	2.7	3.3	1.7	3	4.7	4.3	2.3	3	3.7	2.3	2	3
Piled on slabs	4	3.7	4.3	3.3	4.3	3.7	2.7	2.3	4.3	2	2	3.3	4.7	1	1.5	4	3.5	3.3	3.5	3.3	5	4.5	4.5	4.5	4.5	3	3.7	1.7	3	4.7	4.3	1.7	3	3.3	2	1.3	3
Container - open	4	4	4.3	2.7	4.3	3.3	2.3	1.7	3.7	1.7	1.7	1.3	4	1	1	4	2.5	2	2.5	2.3	5	3	3	3	3	3	3.7	1.3	1.7	4.3	4	2.3	2	2.7	1.7	1.7	2.5
Container - closed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRANSPORT																																					
Open	4	4	4.3	3.7	4.3	3.3	3	2.3	4	2	2	3.7	4.3	1	1	4	2.5	2	2.5	2.3	5	3	3	3	3	3	3.7	2	1.7	4.3	4	2.3	2	2.7	1.7	2	3
Closed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROCESSING																																					
Grinding	4	3.7	4	3.3	5	4.3	2.7	2.7	2.3	2.3	1.7	1.7	4	2	2.5	3	2.5	2.3	2.5	2.7	4	3	2.5	3	3	3	3.7	2.7	3	4.7	4.3	1.3	2.5	3	3	2.3	2
Spray irrigation	2.7	2.7	3.3	2.3	3.3	1.7	1.3	1.3	2.7	3	2	1	2.7	0	0	3	2.5	1.7	2.5	1.7	4	3	3	3	3	2	2	2	2	3	2.7	1	2.5	2	1.7	0.7	2
Incineration	1.3	1.7	1.7	2	1.3	2.7	2.7	3	2.7	2	1.3	0	0.3	1	0.5	1	1	1	1.5	1	1	1.5	1.5	1.5	1.5	1	0.7	0.3	1	2	1.7	1	1.5	1	0.3	0.3	3
Open burning	4.3	3.7	4.3	3.7	5	4.7	4.7	4.3	4.3	3.3	3	0.7	4	1	3	2	3	3.7	3	3.7	2	3	3	3	3	3.7	3.7	2.3	3.7	4.3	4.3	3.7	4.5	4.7	3	2.7	3
Composting	1.3	1.3	1.3	1	2	3	3.3	3.3	2	1	1	1.7	3	1	2	0	0.5	1	0.5	1.3	0	0.5	0.5	0.5	0.5	1.3	1.7	1	1	2	2	1.3	1	2	2	1	0.5
Lagooning	2.3	2.7	2.7	2.3	3.3	1.7	2.3	2.3	2.3	2	2	2	2.7	0	2.5	2	1	2.3	1	2.3	2	1	1	1	1	2	2	3	2.3	3	3	2	2	3	2.7	3.3	1.5
DISPOSAL																																					
Landfill	1	1	0.7	0.7	1	2	2	2	1.3	1	0.7	1.7	1.3	1	1	0	0.5	0.7	0.5	0.7	0	0.5	0.5	0.5	0.5	1	1	0.7	1	1	1	0.7	0.5	0.7	0.7	1	1
Buried	1.3	1.3	1.3	1.3	2	3	2	2	1.7	1.3	0.7	1.7	2	1	1	0	1	1.3	1	1.3	0	1	1	1	1	1.3	1.7	1	1.7	1.7	1.7	0.7	1	1	1	1	1.5
Open dump	4.3	3.7	4.3	3	5	4	3	3	4	2.7	2.3	3.7	5	1	2	3	3	3.3	3	3.3	3	3.5	3.5	3.5	3.5	3.3	4.3	2	3.3	5	5	2.3	3	3.7	3.3	3	4.5
Plowed into ground	3.3	4	3.7	3.3	5	4.7	4.3	4	4	2	1.3	3	3	1	1.5	5	3.5	3	3.5	3	5	3.5	3.5	3.5	3.5	1.7	2	3	3.3	4.3	4.3	2.3	1.5	3.3	3	2.3	3
Pit disposal	1.3	1.3	1.3	1.3	2	3	3	3	1.7	1.3	0.7	2.3	3.3	1	1	0	1	1.3	1	1.3	0	1	1	1	1	1.3	1.7	1	1.7	1.7	1.7	0.7	1	1	1	1.7	1.5

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

UNSIGHTLINESS

(continued)

TYPE OF WASTE WASTE NO. CONDITIONS	97 PETROLEUM	98 PLASTICS	99 MASONRY WASTES	100 METALS	101 SEEDS	102 TIRES		CONDITIONS
UNMANAGED	3.3	2.7	2.3	2.7	1	3.7		4.7
MANAGED:								
STORAGE								
Spread	4	2	3	2.7	1	3.3		4
Piled on ground	3.7	2	1.7	2.3	1	3.7		4
Piled on slabs	3.7	2	1.7	2.3	1	3.7		4
Container - open	3	1.3	1	1.7	1	1		2
Container - closed	0	0	0	0	0	0		0
TRANSPORT								
Open	3.3	1.7	1.7	1.7	1	2.3		3.7
Closed	0	0	0	0	0	0		0
PROCESSING								
Grinding	3.3	2.7	2.3	2.7	1	2.3		2.7
Spray irrigation	2.3	0.7	1	1.3	2	1.7		1.7
Incineration	1	1	1	2	1	3		1
Open burning	4.7	3.7	1.7	3.3	3.3	4.7		4.7
Composting	2.7	3.3	3	3.7	0.7	4.3		2
Lagooning	3.3	2.3	1.7	1.7	2	3.3		2.3
DISPOSAL								
Landfill	2	1	1.7	1.7	0.7	2.7		0.7
Buried	2	1.3	1.7	1.7	0.7	2		1
Open dump	3.3	3	2.3	2.7	1	4		4.3
Plowed into ground	4.7	2.7	4.3	3.7	1	4.7		2
Pit disposal	2	1	2.7	2.3	0.7	2.7		1

Table IV-2 (Continued)

SOLID WASTES PROBLEM DATA

*Ratings identical for all wastes in category shown

TOXICITY

Scored by: D. Mengle, Dr. C. Einert, W. Lewis

CONDITIONS / TYPE OF WASTE / WASTE NO.	1 GARBAGE	2 RESIDENTIAL RUBBISH	3 MIXED GARBAGE	4 STREET REFUSE	5 DEAD ANIMALS	6 ABANDONED VEHICLES	7 DEMOLITION WASTES	8 CONSTRUCTION WASTES	9 SPECIAL WASTES	10 SEWAGE TREAT. RES.	11 WATER TREAT. RES.	12 ASHES	13 HUMAN FECAL MATTER	16-28 FIELD & SEED CROPS*	36-49 VEGETABLE CROPS*	56-71 FRUIT & NUT CROPS*	76-83 MANURES*	86 COTTON TRASH	87 FRUIT & VEGETABLE	88 POULTRY	89 ANIMAL	90 MILK SOLIDS	91 WINE & SPIRITS	92 VEGETABLE OILS	93 TALLOW	94 COTTON, WOOL, & SILK	95 LUMBER & WOOD PRODS.	96 CHEMICALS	97 PETROLEUM	98 PLASTICS	99 MASONRY WASTES	100 METALS	101 SEEDS	102 TIRES		CONDITIONS
UNMANAGED	1	2	1	1	3	2	1	1.5	4.5	1.5	0	0	0	1.5	1	1	1	1	1	2	2	1	2	2	1	1	2	5	3.5	2	1	3	2.5	2		4.5
MANAGED:																																				
STORAGE																																				
Spread	1	2	1	1	0	0	1.5	2	4	1	0	0	0	1	0.5	0.5	0	1	1	1	2	1	2	2	1	0	1	5	3	1	1.5	2	2	0		4
Piled on ground	1	2	1	1	2	2	1.5	1.5	4.5	1.5	0	0	0	1.5	1	1	1	1	1	1	2	0	2	2	1	0	2	5	4	1	1.5	2	2	1		4
Piled on slabs	1	2	1	1	1	2	1.5	1.5	4.5	1.5	0	0	0	1.5	1	1	1	1	1	0	1	2	2	2	1	0	2	5	4	1	1.5	2.5	3	1		4
Container - open	1	2	1	1	2	1	0.5	0.5	4.5	1.5	1	0	0	1.5	1	1	0	1	0	1	2	0	1	2	1	0	1	5	3.5	1	0	2	2.5	0		2.5
Container - closed	1	1	1	1	1	1	0	0	1.5	0.5	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	2.5	1	1	0.5	0.5	0.5	0		1
																																				–
TRANSPORT																																				
Open	1	1	1	1	0	0	2.5	2.5	2.5	1	0	0	0	0.5	0	0	0	0	0	0	0	0	1	1	0	0	1	5	3	0	2.5	0.5	2	0		1.5
Closed	0	0	0	0	0	0	0	0	2.5	0.5	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0		0.5
PROCESSING																																				
Grinding	1	2	1	1	2	1	2	2.5	4.5	1.5	0	0	0	1	1	1	1	1	0	1	1	0	1	1	1	1	1	5	3.5	2	2	2.5	2.5	1		4.5
Spray irrigation	1	1	1	0	1	0	1.5	2.5	4.5	0.5	0	0	0	1.5	0.5	0.5	1	0	0	0	1	0	2	1	1	0	0	5	3.5	0	1.5	3	2	0		3.5
Incineration	0	0	0	0	1	1	1	1	2.5	0.5	0	0	0	0.5	0	0	1	0	0	1	1	0	1	1	0	1	2	5	2	1	1.5	2.5	1	1		2.5
Open burning	0	1	1	1	1	2	1.5	1.5	3	1	0	0	0	1.5	1	1	1	0	0	0	0	0	1	1	0	1	2	5	2.5	1	1.5	3	1.5	2		3
Composting	0	1	1	0	1	0	1	1	3.5	0.5	0	0	0	1	0.5	0.5	1	0	0	1	1	0	2	2	1	1	2	5	2.5	0	1	2.5	1	0		2.5
Lagooning	1	0	0	1	3	2	0	0	3.5	1	0	0	0	1	0.5	0	1	1	0	1	1	0	2	2	1	0	1	5	3.5	1	0	2	1.5	0		2.5
DISPOSAL																																				
Landfill	0	1	0	0	2	1	0	0	2.5	0	0	0	0	0.5	0.5	0.5	0	0	0	1	1	0	0	0	0	0	0	5	2.5	0	0	1.5	1.5	0		1
Buried	0	1	0	0	0	1	0	0	2.5	0	0	0	0	1.5	0.5	0.5	1	1	0	1	1	0	0	1	1	0	0	5	3	0	0	1.5	2.5	0		2.5
Open dump	1	2	1	1	2	2	0.5	1	3.5	1.5	1	0	0	1.5	1	1	1	1	1	1	1	1	1	2	2	1	1	5	3.5	1	0.5	2.5	2.5	1		4
Plowed into ground	0	2	1	0	0	0	0.5	0.5	3	0.5	0	0	0	1	0.5	0.5	0	1	0	0	0	0	0	1	2	0	0	5	2.5	0	0.5	2	1.5	0		2
Pit disposal	0	1	1	1	2	1	0	0.5	3	0.5	1	0	0	1.5	1	1	1	0	1	1	1	0	1	1	1	0	0	5	3	1	0	2	2	1		2.5

Table IV-3

BASIC BAD EFFECTS SCORES

Flies

	[illegible]	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
GARBAGE	20.2	1.0	25.0	23.5	18.5	15.0	0.0	0.0	0.0	0.0	0.0	12.2	0.0	0.0	0.0	9.9	25.0	3.9	11.5
RES RUBBISH	0.0	1.0	13.5	12.7	11.1	6.9	0.0	0.0	0.5	0.2	0.0	6.5	0.0	0.0	0.0	6.2	16.5	1.7	6.9
MIXED GARBAGE	17.2	1.0	22.5	21.1	13.5	13.5	0.0	0.0	0.3	0.0	0.0	9.2	0.0	0.0	0.0	9.2	22.5	3.2	10.3
STREET REFUSE	11.0	0.0	13.5	12.7	11.1	9.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	3.9	13.5	1.7	3.9
DEAD ANIMALS	21.5	5.0	25.0	23.5	18.5	15.0	0.0	0.0	1.4	0.7	0.0	14.0	0.0	0.0	0.0	9.9	25.0	2.2	9.9
ABANDON VEHIC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEMOLITION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPECIAL	21.5	4.0	25.0	23.5	13.5	15.0	0.0	0.0	1.4	1.2	0.0	11.1	0.0	0.0	0.0	9.9	25.0	3.0	6.2
SEWAGE TR SLDG	20.2	0.0	23.5	22.1	13.7	5.1	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	0.0	3.9	23.5	0.9	6.9
WATER TR SLDG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ASHES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HUMAN FECES	20.2	5.0	25.0	23.5	17.4	11.1	0.0	0.0	1.2	2.1	0.0	12.2	0.0	0.0	0.0	6.2	25.0	4.3	9.9
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARLEY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEANS DRY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CORN	4.5	0.0	10.0	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	10.0	0.0	0.0
COTTON LINT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON SEED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HAY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OATS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALFALFA	0.0	0.0	10.0	14.1	7.4	6.0	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	10.0	0.0	0.0
RICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAFFLOWER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SORGHUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUGAR BEETS	6.6	0.0	15.0	14.1	0.0	0.0	0.0	0.0	0.7	0.7	0.0	11.1	0.0	0.0	0.0	0.0	15.0	0.0	4.6
WHEAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEANS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CABBAGE	6.6	1.0	22.5	21.1	12.9	9.0	0.0	0.0	0.0	0.0	0.0	12.5	0.0	0.0	0.0	2.3	22.5	1.9	0.0
CHINESE VEGS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SWEET CORN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CUCUMBERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MELONS	15.9	3.0	21.5	20.2	13.7	11.1	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	2.3	21.5	2.6	0.0
ONIONS	4.0	0.0	25.0	23.5	18.5	15.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	0.0	6.9	25.0	1.3	9.2
PEPPERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RADISHES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROMAINE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SQUASH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SWEET POTATOES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOMATOES	20.2	1.7	23.5	22.1	15.9	12.9	0.0	0.0	0.0	0.0	0.0	15.9	0.0	0.0	0.0	5.3	23.5	2.2	0.7
TURNIPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table IV-4

BAD EFFECTS RANKING

BAD EFFECTS RANKING INDUSTRIAL SUB-REGION	FLIES	OTHER INSECTS	RODENTS	PLANT DISEASE	ANIMAL DISEASE	HUMAN DISEASE	WATER POLLUTION	AIR POLLUTION	LAND POLLUTION	TOXICITY HAZARDS	SAFETY HAZARDS	ODOR	UNSIGHTLINESS	TOTAL (RANK)	RELATIVE IMPORTANCE WEIGHT
FLIES	-	1 / 0	1 / 0	1 / 0	1 / 0	0 / 1	0 / 1	0 / 1	1 / 0	0 / 1	0 / 1	1 / 0	1 / 0	7	35
OTHER INSECTS		-	0 / 1	1 / 0	1 / 0	0 / 1	0 / 1	0 / 1	1 / 0	0 / 1	0 / 1	0 / 1	0 / 1	3	10
RODENTS			-	1 / 0	1 / 0	0 / 1	0 / 1	0 / 1	1 / 0	0 / 1	0 / 1	0 / 1	0 / 1	4	15
PLANT DISEASE				-	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0	2
ANIMAL DISEASE					-	0 / 1	0 / 1	0 / 1	1 / 0	0 / 1	0 / 1	0 / 1	0 / 1	2	5
HUMAN DISEASE						-	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	12	100
WATER POLLUTION							-	1 / 0	1 / 0	0 / 1	0 / 1	1 / 0	1 / 0	9	45
AIR POLLUTION								-	1 / 0	0 / 1	0 / 1	1 / 0	1 / 0	8	40
LAND POLLUTION									-	0 / 1	0 / 1	0 / 1	0 / 1	1	3
TOXICITY HAZARDS										-	0 / 1	1 / 0	1 / 0	10	50
SAFETY HAZARDS											-	1 / 0	1 / 0	11	60
ODOR												-	1 / 0	6	30
UNSIGHTLINESS													-	5	20

Table IV-4 (Continued)

BAD EFFECTS RANKING

BAD EFFECTS RANKING MUNICIPAL SUB-REGION	FLIES	OTHER INSECTS	RODENTS	PLANT DISEASE	ANIMAL DISEASE	HUMAN DISEASE	WATER POLLUTION	AIR POLLUTION	LAND POLLUTION	TOXICITY HAZARDS	SAFETY HAZARDS	ODOR	UNSIGHTLINESS	TOTAL (RANK)	RELATIVE IMPORTANCE WEIGHT
FLIES	-	1/0	1/0	1/0	1/0	0/1	0/1	0/1	1/0	0/1	0/1	1/0	1/0	7	30
OTHER INSECTS		-	0/1	1/0	1/0	0/1	0/1	0/1	1/0	0/1	0/1	0/1	0/1	3	10
RODENTS			-	1/0	1/0	0/1	0/1	0/1	1/0	0/1	0/1	1/0	1/0	6	25
PLANT DISEASE				-	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0	3
ANIMAL DISEASE					-	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	1	5
HUMAN DISEASE						-	1/0	1/0	1/0	1/0	1/0	1/0	1/0	12	100
WATER POLLUTION							-	1/0	1/0	1/0	0/1	1/0	1/0	10	60
AIR POLLUTION								-	1/0	1/0	0/1	1/0	1/0	9	50
LAND POLLUTION									-	0/1	0/1	0/1	0/1	2	8
TOXICITY HAZARDS										-	0/1	1/0	1/0	8	40
SAFETY HAZARDS											-	1/0	1/0	11	70
ODOR												-	1/0	5	20
UNSIGHTLINESS													-	4	15

Table IV-4 (Continued)
BAD EFFECTS RANKING

BAD EFFECTS RANKING INTERFACE SUB-REGION	FLIES	OTHER INSECTS	RODENTS	PLANT DISEASE	ANIMAL DISEASE	HUMAN DISEASE	WATER POLLUTION	AIR POLLUTION	LAND POLLUTION	TOXICITY HAZARDS	SAFETY HAZARDS	ODOR	UNSIGHTLINESS	TOTAL (RANK)	RELATIVE IMPORTANCE WEIGHT
FLIES	-	1 / 0	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	1 / 0	0 / 1	0 / 1	1 / 0	1 / 0	4	30
OTHER INSECTS		-	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	1 / 0	1	12
RODENTS			-	1 / 0	0 / 1	0 / 1	0 / 1	0 / 1	1 / 0	0 / 1	0 / 1	1 / 0	1 / 0	6	30
PLANT DISEASE				-	0 / 1	0 / 1	0 / 1	0 / 1	1 / 0	0 / 1	0 / 1	1 / 0	1 / 0	5	30
ANIMAL DISEASE					-	0 / 1	0 / 1	1 / 0	1 / 0	1 / 0	0 / 1	1 / 0	1 / 0	9	35
HUMAN DISEASE						-	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	12	100
WATER POLLUTION							-	1 / 0	1 / 0	1 / 0	0 / 1	1 / 0	1 / 0	10	60
AIR POLLUTION								-	1 / 0	0 / 1	0 / 1	1 / 0	1 / 0	7	35
LAND POLLUTION									-	0 / 1	0 / 1	1 / 0	1 / 0	3	25
TOXICITY HAZARDS										-	0 / 1	1 / 0	1 / 0	8	35
SAFETY HAZARDS											-	1 / 0	1 / 0	11	70
ODOR												-	1 / 0	2	15
UNSIGHTLINESS													-	0	10

Table IV-4 (Continued)

BAD EFFECTS RANKING

BAD EFFECTS RANKING AGRICULTURAL SUB-REGION	FLIES	OTHER INSECTS	RODENTS	PLANT DISEASE	ANIMAL DISEASE	HUMAN DISEASE	WATER POLLUTION	AIR POLLUTION	LAND POLLUTION	TOXICITY HAZARDS	SAFETY HAZARDS	ODOR	UNSIGHTLINESS	TOTAL (RANK)	RELATIVE IMPORTANCE WEIGHT
FLIES	-	1 / 0	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	1 / 0	0 / 1	1 / 0	0 / 1	1 / 0	1 / 0	5	30
OTHER INSECTS		-	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	1 / 0	0 / 1	0 / 1	0 / 1	1 / 0	1 / 0	3	15
RODENTS			-	0 / 1	0 / 1	0 / 1	0 / 1	1 / 0	0 / 1	1 / 0	0 / 1	1 / 0	1 / 0	6	45
PLANT DISEASE				-	0 / 1	0 / 1	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	10	75
ANIMAL DISEASE					-	0 / 1	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	11	80
HUMAN DISEASE						-	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	12	100
WATER POLLUTION							-	1 / 0	1 / 0	1 / 0	0 / 1	1 / 0	1 / 0	8	60
AIR POLLUTION								-	0 / 1	0 / 1	0 / 1	1 / 0	1 / 0	2	10
LAND POLLUTION									-	1 / 0	0 / 1	1 / 0	1 / 0	7	50
TOXICITY HAZARDS										-	0 / 1	1 / 0	1 / 0	4	25
SAFETY HAZARDS											-	1 / 0	1 / 0	9	70
ODOR												-	1 / 0	1	5
UNSIGHTLINESS													-	0	3

Table IV-5

ESTIMATED CONTRIBUTION OF SOLID WASTES TO BAD EFFECTS BY SUB-REGIONAL CATEGORIES

(% OF TOTAL CONTRIBUTION)

BAD EFFECTS	CONTRIBUTORS	INDUSTRIAL	MUNICIPAL	INTERFACE	AGRICULTURAL
HUMAN DISEASE Ingestion)bacteria, Inhalation)virus, Contact)fungi, etc.	Food, water, air, social intercourse, cuts, wounds, toxic materials, infected animals, solid wastes	1%	2%	5%	10%
ANIMAL DISEASE	Similar to human disease	1%	2%	5%	20%
PLANT DISEASE (Crop Damage)	Infected plants (living), air pollution, toxic materials, i.e., herbicides, pesticides, noxious weeds, wild animals, rodents, solid wastes, insects	1%	2%	5%	15%
FLIES	Solid wastes	100%	100%	100%	100%
OTHER INSECTS	Liquid wastes, stagnant water, edible foods, solid wastes	50%	40%	30%	20%

Table IV-5 (Continued)

ESTIMATED CONTRIBUTION OF SOLID WASTES TO BAD EFFECTS BY SUB-REGIONAL CATEGORIES

BAD EFFECTS	CONTRIBUTORS	INDUSTRIAL	MUNICIPAL	INTERFACE	AGRICULTURAL
RODENTS	Edible food, growing plants, solid wastes	50%	40%	30%	20%
WATER POLLUTION	Agricultural chemicals, sewage (liquid), industrial processes (liquid), solid wastes	20%	30%	50%	80%
AIR POLLUTION	Auto emissions, industrial processes, natural dusts, solid wastes (incineration, open burning)	20%	30%	40%	60%
LAND POLLUTION	Poor drainage, sewage (liquid), agricultural chemicals and fertilizers, industrial processes, solid wastes	50%	10%	10%	10%
TOXICITY HAZARDS	Stored chemicals, industrial processes, liquid wastes, agricultural chemicals, solid wastes	1%	5%	7%	10%

Table IV-5 (Continued)

ESTIMATED CONTRIBUTION OF SOLID WASTES TO BAD EFFECTS BY SUB-REGIONAL CATEGORIES

BAD EFFECTS	CONTRIBUTORS	INDUSTRIAL	MUNICIPAL	INTERFACE	AGRICULTURAL
SAFETY HAZARDS	Industrial processes, traffic hazards, home accidents, recreational activities, solid wastes	5%	10%	5%	1%
ODOR	Industrial processes, water pollution (X),* air pollution (X), solid wastes, commercial endeavors	5%	10%	40%	80%
UNSIGHTLINESS	Neglected structures, power and telephone lines, water (X) pollution, air pollution (X), land pollution (X), weeds, solid wastes, bulk material, storage	10%	20%	30%	40%

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*(X) Contributors are also bad effects.

Table IV-6

INFLUENCE COEFFICIENTS, BAD EFFECTS

Bad Effects	Relative Importance	Relative Contribution of Solid Waste	Weighted Relative Importance*	Influence Coefficient**
		Industrial Subregion		
Flies	35	100	3500	0.082
Other insects	10	50	500	0.012
Rodents	15	50	750	0.017
Air pollution	40	20	800	0.019
Water pollution	45	20	900	0.021
Human disease	100	1	100	0.002
Animal disease	5	1	5	0
Crop damage and plant disease	2	1	2	0
Odor	30	5	150	0.003
Unsightliness	20	10	200	0.005
Safety hazards	60	5	300	0.007
Toxicity	50	1	50	0.001
Land pollution	3	50	150	0.003
		Municipal Subregion		
Flies	30	100	3000	0.070
Other insects	10	40	400	0.009
Rodents	25	40	1000	0.023
Air pollution	50	30	1500	0.035
Water pollution	60	30	1800	0.042
Human disease	100	2	200	0.005
Animal disease	5	2	10	0
Crop damage and plant disease	3	2	6	0
Odor	20	10	200	0.005
Unsightliness	15	20	300	0.007
Safety hazards	70	10	700	0.016
Toxicity	40	5	200	0.005
Land pollution	8	10	80	0.002

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* Throughout Table, weighted relative importance = relative importance times relative contribution of solid wastes.

**Throughout Table, influence coefficient = weighted relative importance normalized.

Table IV-6

INFLUENCE COEFFICIENTS, BAD EFFECTS (Continued)

Bad Effects	Relative Importance	Relative Contribution of Solid Waste	Weighted Relative Importance*	Influence Coefficient**
Interface Subregion				
Flies	30	100	3000	0.070
Other insects	12	30	360	0.008
Rodents	30	30	900	0.021
Air pollution	35	40	1400	0.033
Water pollution	60	50	3000	0.070
Human disease	100	5	500	0.012
Animal disease	35	5	175	0.004
Crop damage and plant disease	30	5	150	0.003
Odor	15	40	600	0.014
Unsightliness	10	30	300	0.007
Safety hazards	70	5	350	0.008
Toxicity	35	7	245	0.006
Land pollution	25	10	250	0.006
Agricultural Subregion				
Flies	30	100	3000	0.070
Other insects	15	20	300	0.007
Rodents	45	20	900	0.021
Air pollution	10	60	600	0.014
Water pollution	60	80	4800	0.112
Human disease	100	10	1000	0.023
Animal disease	80	20	1600	0.037
Crop damage and plant disease	75	15	1125	0.026
Odor	5	80	400	0.009
Unsightliness	3	40	120	0.003
Safety hazards	70	1	70	0.002
Toxicity	25	10	250	0.006
Land pollution	50	10	500	0.012

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* Throughout Table, weighted relative importance = relative importance times relative contribution of solid wastes.

**Throughout Table, influence coefficient = weighted relative importance normalized.

Table IV-7

TOTAL WEIGHTED BAD EFFECTS SCORES

WASTE RES RUBBISH SUB REGION MUNICIPAL

	FLIES	WATER POLL	AIR POLL	RODENT	HUMAN DISEASE	ANIMAL DISEASE	OTHER INSECTS	SAFETY HAZARDS	ODOR	PLANT DISEASE	LAND POLL	UN SIGHTLY	TOXIC	WEIGHTED BAD EFFECT 1	2
UNMANAGED	0.60	0.28	0.07	0.41	0.05	0.0	0.14	0.21	0.09	0.0	0.04	0.14	0.04	2.09	1.81
SPREAD	0.07	0.19	0.14	0.11	0.02	0.0	0.09	0.14	0.09	0.0	0.04	0.12	0.04	1.06	0.67
PILED ON GRD	0.94	0.17	0.27	0.52	0.04	0.0	0.18	0.19	0.07	0.0	0.04	0.10	0.04	2.56	2.39
PILED ON SLB	0.89	0.06	0.12	0.52	0.04	0.0	0.16	0.19	0.05	0.0	0.03	0.10	0.04	2.20	2.14
CONT OPEN	0.78	0.01	0.07	0.18	0.03	0.0	0.13	0.08	0.03	0.0	0.02	0.06	0.02	1.41	1.40
CONT CLOSED	0.48	0.0	0.01	0.01	0.01	0.0	0.06	0.03	0.00	0.0	0.03	0.0	0.00	0.64	0.64
TRANS OPEN	0.0	0.01	0.14	0.01	0.01	0.0	0.08	0.10	0.02	0.0	0.0	0.10	0.01	0.47	0.46
TRANS CLOSED	0.0	0.0	0.00	0.0	0.0	0.0	0.03	0.02	0.0	0.0	0.0	0.0	0.0	0.05	0.05
GRINDING	0.03	0.0	0.19	0.03	0.03	0.0	0.06	0.06	0.01	0.0	0.02	0.07	0.04	0.55	0.55
SPRAY IRRG	0.01	0.35	0.26	0.07	0.01	0.0	0.06	0.13	0.01	0.0	0.02	0.03	0.02	0.97	0.63
INCINERATE	0.0	0.14	0.28	0.0	0.01	0.0	0.01	0.06	0.01	0.0	0.0	0.01	0.0	0.53	0.38
OPEN BURN	0.44	0.28	0.75	0.14	0.02	0.0	0.09	0.36	0.09	0.0	0.03	0.12	0.01	2.35	2.06
COMPOSTING	0.0	0.19	0.05	0.02	0.00	0.0	0.00	0.06	0.00	0.0	0.0	0.02	0.01	0.36	0.17
LAGOONING	0.0	0.69	0.09	0.01	0.0	0.0	0.02	0.21	0.00	0.0	0.0	0.04	0.0	1.07	0.37
LANDFILL	0.0	0.19	0.0	0.02	0.00	0.0	0.01	0.03	0.01	0.0	0.02	0.00	0.00	0.29	0.09
BURIED	0.43	0.23	0.01	0.01	0.02	0.0	0.02	0.07	0.01	0.0	0.03	0.01	0.01	0.85	0.62
OPEN DUMP	1.15	0.47	0.48	0.57	0.07	0.0	0.16	0.17	0.06	0.0	0.04	0.11	0.04	3.33	2.87
FLL IN GRD	0.12	0.28	0.03	0.02	0.01	0.0	0.06	0.07	0.02	0.0	0.04	0.06	0.02	0.74	0.46
PIT DISPOSAL	0.48	0.50	0.02	0.05	0.0	0.0	0.07	0.05	0.03	0.0	0.03	0.01	0.01	1.24	0.74

NOTE UNDER WEIGHTED BAD EFFECT COLUMN 1 CONSIDERS WATER POLLUTION IS POSSIBLE COLUMN 2 CONSIDERS WATER POLLUTION NOT POSSIBLE

Table IV-8

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION CONSIDERED POSSIBLE

SUB REGION INDUSTRIAL

	URBAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGOON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
GARBAGE	3.05	0.93	3.38	3.15	2.44	1.50	0.52	0.06	0.54	0.33	0.34	2.29	0.20	0.65	0.27	1.18	3.81	0.92	1.56
RES RUBBISH	1.72	0.74	2.24	2.00	1.40	0.71	0.32	0.05	0.39	0.59	0.28	1.65	0.19	0.55	0.17	0.76	2.78	0.55	1.04
PLACE GARBAGE	2.00	0.53	3.15	2.95	2.30	1.34	0.49	0.06	0.47	0.72	0.29	1.96	0.17	0.64	0.23	1.10	3.52	0.72	1.47
STREET REFUSE	1.55	0.45	[illegible]	1.51	1.23	0.85	0.33	0.04	0.31	0.41	0.27	1.07	0.14	0.47	0.15	0.56	1.97	0.45	0.72
DEAD ANIMALS	3.17	1.42	[illegible]	[illegible]	2.59	1.55	0.54	0.08	0.74	0.36	0.38	2.62	0.33	0.50	0.32	1.25	3.82	0.80	1.62
ABANDON VEHIC	0.75	0.19	0.43	0.37	0.25	0.13	0.13	0.02	0.18	0.15	0.32	0.99	0.08	0.04	0.13	0.25	1.18	0.34	0.50
DEMOLITION	0.35	0.41	0.70	0.65	0.31	0.12	0.28	0.04	0.22	0.12	0.23	0.72	0.06	0.07	0.11	0.15	1.23	0.31	0.37
CONSTRUCTION	0.32	0.35	0.50	0.45	0.30	0.11	0.27	0.04	0.20	0.11	0.24	0.74	0.04	0.07	0.11	0.15	1.22	0.31	0.33
SPECIAL	2.81	1.11	2.95	2.60	2.05	1.42	0.23	0.04	0.49	0.70	0.39	2.11	0.36	0.68	0.31	1.24	3.22	0.79	1.14
SEWAGE TR SLDG	2.49	0.49	2.62	2.45	1.55	0.81	0.31	0.04	0.36	0.42	0.33	1.75	0.17	0.46	0.15	0.59	2.89	0.39	1.05
WATER TR SLDG	0.51	0.30	0.41	0.15	0.22	0.10	0.17	0.02	0.25	0.34	0.27	0.75	0.19	0.39	0.13	0.19	0.75	0.19	0.30
[illegible]	0.40	0.33	0.35	0.32	0.19	0.05	0.27	0.01	0.27	0.27	0.16	0.36	0.07	0.12	0.13	0.15	0.51	0.27	0.34
HUMAN FECES	2.92	1.19	3.22	2.95	2.20	1.19	0.63	0.10	0.64	0.97	0.48	2.22	0.29	0.64	0.33	0.91	3.44	0.89	1.48
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARLEY	0.61	0.46	0.63	0.59	0.39	0.03	0.07	0.00	0.28	0.38	0.28	0.70	0.13	0.25	0.10	0.13	0.88	0.18	0.26
BEANS DRY	0.16	0.43	0.64	0.60	0.30	0.03	0.09	0.00	0.25	0.39	0.29	0.30	0.12	0.27	0.10	0.13	0.96	0.18	0.22
CORN	0.93	0.45	1.46	1.37	0.30	0.03	0.09	0.00	0.25	0.39	0.29	1.16	0.12	0.27	0.10	0.13	1.78	0.18	0.22
COTTON LINT	0.55	0.46	0.62	0.58	0.35	0.03	0.08	0.00	0.25	0.34	0.27	[illegible]	0.12	0.27	0.10	0.13	0.89	0.18	0.22
COTTON SEED	0.53	0.43	0.64	0.60	0.36	0.03	0.09	0.00	0.25	0.39	0.29	0.30	0.12	0.27	0.10	0.13	0.96	0.18	0.22
HAY	0.36	0.43	0.64	0.53	0.30	0.03	0.09	0.00	0.25	0.39	0.29	0.30	0.12	0.27	0.10	0.13	0.96	0.18	0.22
OATS	0.63	[illegible]	[illegible]	0.64	0.43	0.03	0.09	0.00	0.28	0.43	0.27	0.65	0.14	0.27	0.11	0.13	1.00	0.18	0.26
ALFALFA	[illegible]	0.45	1.50	1.60	1.04	0.55	0.09	0.00	0.28	0.43	[illegible]	1.05	0.14	0.27	0.11	0.13	1.82	0.18	0.26
RICE	[illegible]	0.40	0.63	0.59	0.39	0.03	0.07	0.00	0.23	0.38	0.26	0.70	0.12	0.25	0.10	0.13	0.86	0.17	0.26
SAFFLOWER	[illegible]	0.43	0.64	0.60	0.30	0.03	0.09	0.00	0.25	0.39	0.29	0.30	0.12	0.27	0.10	0.13	0.96	0.18	0.22
SORGHUM	[illegible]	0.43	0.64	0.60	0.30	0.04	0.09	0.00	0.25	0.39	0.29	0.30	0.12	0.27	0.10	0.13	0.96	0.18	0.22
SUGAR BEETS	[illegible]	0.47	1.91	1.80	0.43	0.04	0.09	0.00	0.34	0.49	0.29	1.55	0.14	0.29	0.11	0.13	2.23	0.22	0.64
WHEAT	0.61	0.40	0.63	0.59	0.39	0.03	0.07	0.00	0.28	0.38	0.25	0.70	0.13	0.25	0.10	0.13	0.88	0.18	0.26
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEANS	0.37	0.60	0.54	0.94	0.31	0.12	0.47	0.05	0.46	0.65	0.30	0.98	0.11	0.45	0.17	0.22	1.46	0.36	0.41
CARROTS	1.51	0.66	2.80	2.70	1.39	0.87	0.44	0.05	0.47	0.63	0.33	2.14	0.12	0.51	0.18	0.43	3.32	0.52	0.41
CHINESE VEGS	0.37	0.60	0.94	0.94	0.31	0.12	0.47	0.05	0.46	0.65	0.30	0.98	0.11	0.45	0.17	0.22	1.46	0.36	0.41
SWEET CORN	0.37	0.60	0.54	0.94	0.31	0.12	0.47	0.05	0.46	0.65	0.30	0.98	0.11	0.45	0.17	0.22	1.46	0.36	0.41
CUCUMBERS	0.37	0.60	0.94	0.94	0.31	0.12	0.47	0.05	0.46	0.65	0.30	0.98	0.11	0.45	0.17	0.22	1.46	0.36	0.41
MELONS	2.21	0.77	2.72	2.51	1.94	1.05	0.44	0.05	0.47	0.63	0.33	2.31	0.13	0.52	0.18	0.43	3.24	0.57	0.41
ONIONS	1.30	0.60	2.59	2.07	2.32	1.55	0.47	0.05	0.46	0.65	0.30	1.49	0.11	0.45	0.17	0.79	3.51	0.46	1.16
PEPPERS	0.37	0.60	0.94	0.94	0.31	0.12	0.47	0.05	0.46	0.55	0.30	0.98	0.11	0.45	0.17	0.22	1.46	0.36	0.41
RADISHES	0.39	0.60	0.94	0.94	0.31	0.12	0.47	0.05	0.46	0.65	0.30	0.98	0.11	0.45	0.17	0.22	1.46	0.36	0.41
ROMAINE	0.37	0.60	0.54	0.94	0.31	0.12	0.47	0.05	0.46	0.65	0.30	0.95	0.11	0.45	0.17	0.22	1.46	0.36	0.41
SQUASH	0.37	0.53	0.93	0.95	0.79	0.12	0.44	0.05	0.46	0.64	0.31	1.01	0.12	0.44	0.17	0.22	1.46	0.34	0.41
SWEET POTATOES	[illegible]	0.60	0.94	0.94	0.31	0.12	0.47	0.05	0.46	0.65	0.30	0.98	0.11	0.45	0.17	0.22	1.46	0.36	0.41
TOMATOES	[illegible]	0.73	[illegible]	2.77	2.15	1.19	0.44	0.05	0.48	0.64	0.33	2.40	0.13	0.52	0.15	0.58	3.40	0.56	0.47
TURNIPS	0.37	0.60	0.94	0.94	0.31	0.12	0.47	0.05	0.46	0.65	0.30	0.98	0.11	0.45	0.17	0.22	1.45	0.36	0.41
VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table IV-8 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION CONSIDERED POSSIBLE

SUB REGION INDUSTRIAL

	UNMAN	SPRD	FILED ON GRD	FILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALMONDS	0.53	0.35	0.57	0.53	0.40	0.03	0.05	0.00	0.26	0.46	0.27	0.86	0.09	0.33	0.13	0.15	0.79	0.23	0.34
APRICOTS	1.67	0.46	2.39	2.24	1.44	0.76	0.27	0.01	0.36	0.53	0.25	1.32	0.09	0.35	0.14	0.33	2.60	0.51	0.32
BOSNBERRIES	0.53	0.35	0.64	0.60	0.33	0.04	0.18	0.01	0.30	0.46	0.25	0.59	0.09	0.33	0.14	0.17	0.87	0.25	0.32
FIGS	1.45	0.57	2.09	1.96	1.00	0.41	0.23	0.01	0.35	0.52	0.25	1.41	0.11	0.36	0.14	0.27	2.30	0.32	0.45
GRAPEFRUIT	1.23	0.41	1.86	1.74	0.62	0.29	0.15	0.01	0.29	0.45	0.25	1.52	0.07	0.32	0.14	0.17	2.11	0.24	0.32
GRAPES	1.38	0.43	2.17	2.03	1.48	0.65	0.27	0.01	0.30	0.46	0.25	1.78	0.09	0.33	0.14	0.41	2.38	0.29	0.32
LEMONS	1.22	0.40	1.86	1.74	0.62	0.29	0.15	0.01	0.28	0.45	0.25	1.32	0.09	0.32	0.14	0.17	2.11	0.24	0.32
NECTARINES	1.62	0.59	2.55	2.38	1.48	0.79	0.27	0.01	0.35	0.50	0.26	1.64	0.10	0.40	0.14	0.17	2.74	0.32	0.32
OLIVES	0.55	0.35	0.64	0.60	0.33	0.04	0.18	0.01	0.30	0.46	0.25	0.59	0.07	0.34	0.14	0.17	0.87	0.25	0.32
ORANGES	1.20	0.47	1.90	1.79	0.90	0.46	0.15	0.01	0.31	0.49	0.25	1.51	0.11	0.34	0.14	0.23	2.15	0.28	0.36
PEACHES	1.92	0.59	2.94	2.75	1.79	0.97	0.33	0.01	0.39	0.55	0.22	2.16	0.12	0.41	0.15	0.51	3.15	0.45	0.36
PERSIMMONS	0.53	0.35	0.64	0.60	0.33	0.04	0.18	0.01	0.30	0.46	0.25	0.59	0.09	0.33	0.14	0.17	0.87	0.25	0.32
PLUMS	1.59	0.49	2.51	2.44	1.44	0.72	0.27	0.01	0.36	0.51	0.26	1.93	0.10	0.40	0.14	0.37	2.79	0.32	0.32
POMEGRANATES	0.53	0.35	0.64	0.60	0.33	0.04	0.18	0.01	0.30	0.46	0.25	0.69	0.09	0.33	0.14	0.17	0.87	0.25	0.32
STRAWBERRIES	0.53	0.35	0.64	0.60	0.33	0.04	0.22	0.01	0.39	0.59	0.25	0.59	0.09	0.40	0.14	0.17	0.94	0.25	0.33
WALNUTS	0.65	0.43	1.39	1.30	0.40	0.03	0.05	0.00	0.27	0.46	0.29	0.69	0.37	0.33	0.14	0.15	1.61	0.27	0.34
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CATTLE MANURE	2.84	0.80	3.25	3.02	1.76	0.54	0.38	0.06	0.52	0.68	0.34	2.37	0.22	0.60	0.22	1.15	3.64	0.55	1.14
SHEEP MANURE	1.11	0.56	1.93	1.76	0.82	0.42	0.37	0.06	0.38	0.55	0.28	1.21	0.21	0.55	0.20	0.66	2.25	0.35	0.66
HOG MANURE	2.57	0.64	2.91	2.68	1.45	0.84	0.33	0.06	0.40	0.57	0.29	2.26	0.20	0.55	0.20	1.08	3.16	0.52	0.83
HORSE MANURE	1.97	0.56	2.81	2.58	1.46	0.84	0.35	0.06	0.38	0.55	0.28	1.71	0.20	0.55	0.20	0.87	3.07	0.48	0.75
CHICK MANURE	2.62	0.54	2.87	2.66	1.64	0.92	0.37	0.06	0.39	0.61	0.30	2.39	0.19	0.59	0.21	1.03	3.24	0.54	1.19
TURKEY MANURE	1.20	0.54	2.02	1.84	1.08	0.67	0.33	0.06	0.39	0.55	0.23	1.56	0.20	0.56	0.19	0.70	2.24	0.36	0.66
PIGEON MANURE	1.77	0.57	2.12	1.94	1.37	0.71	0.32	0.06	0.38	0.54	0.28	1.36	0.20	0.56	0.19	0.62	2.55	0.46	0.60
RABBIT MANURE	1.37	0.56	2.28	2.08	1.29	0.67	0.35	0.06	0.38	0.58	0.27	1.35	0.20	0.56	0.19	0.68	2.52	0.51	0.79
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON TRASH	1.09	0.35	1.27	1.20	0.58	0.30	0.19	0.01	0.30	0.42	0.26	1.02	0.15	0.43	0.11	0.24	1.67	0.29	0.32
FRUIT AND VEG	2.62	0.68	3.16	2.92	1.94	0.85	0.31	0.03	0.46	0.64	0.32	2.57	0.23	0.61	0.18	0.75	3.44	0.43	0.71
POULTRY	3.04	1.13	3.27	3.08	2.26	1.32	0.51	0.11	0.66	0.84	0.45	2.55	0.23	0.81	0.25	0.49	3.64	0.67	1.03
ANIMAL	3.05	1.15	3.33	3.10	2.26	1.32	0.50	0.12	0.63	0.84	0.43	2.56	0.25	0.77	0.22	0.65	3.61	0.72	0.96
MILK SOLIDS	1.72	0.50	1.85	1.66	1.88	1.06	0.23	0.02	0.43	0.60	0.38	1.71	0.26	0.63	0.12	0.50	2.13	0.25	0.50
SPIRITS	2.28	0.62	2.48	2.29	1.62	0.93	0.27	0.07	0.39	0.67	0.32	2.01	0.20	0.52	0.17	0.63	2.85	0.44	0.59
VEGET OILS	1.51	0.35	2.47	2.32	1.47	0.58	0.14	0.01	0.22	0.52	0.20	1.22	0.12	0.38	0.15	0.77	2.62	0.27	0.29
TALLOW	2.67	0.91	2.90	2.67	1.91	1.28	0.31	0.06	0.37	0.64	0.29	2.01	0.22	0.64	0.17	0.84	3.21	0.46	0.80
TEXTILES	0.64	0.22	0.60	0.58	0.09	0.04	0.07	0.01	0.23	0.20	0.18	0.70	0.11	0.16	0.04	0.05	0.83	0.15	0.15
WOOD PRODUCTS	0.57	0.31	0.65	0.56	0.10	0.02	0.10	0.0	0.23	0.22	0.20	0.55	0.13	0.23	0.05	0.08	0.97	0.14	0.15
CHEMICALS	0.97	0.76	0.79	0.60	0.35	0.11	0.31	0.02	0.43	0.73	0.39	0.94	0.37	0.73	0.36	0.46	0.94	0.54	0.58
PETROLEUM	0.80	0.70	0.59	0.59	0.35	0.10	0.28	0.01	0.38	0.66	0.28	0.95	0.22	0.72	0.51	0.43	0.98	0.49	0.58
PLASTICS	0.40	0.29	0.23	0.15	0.09	0.03	0.07	0.01	0.23	0.47	0.37	1.05	0.21	0.45	0.15	0.22	0.80	0.25	0.29
MASONARY	0.76	0.31	0.85	0.78	0.20	0.06	0.18	0.02	0.21	0.16	0.03	0.19	0.06	0.09	0.07	0.12	0.93	0.22	0.33
METALS	0.73	0.33	0.84	0.75	0.29	0.11	0.22	0.05	0.15	0.28	0.05	0.32	0.08	0.23	0.14	0.21	0.95	0.32	0.43
SEEDS	1.64	0.42	2.22	2.00	1.08	0.29	0.16	0.01	0.31	0.55	0.13	1.19	0.16	0.51	0.22	0.55	2.49	0.29	0.42
TIRES	0.38	0.35	0.85	0.82	0.61	0.06	0.11	0.01	0.30	0.09	0.42	1.04	0.17	0.09	0.33	0.13	1.13	0.22	0.35

Table IV-8 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION CONSIDERED POSSIBLE

SJS REGION MUNICIPAL

	UNCAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	CONST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
GARBAGE	3.35	1.40	3.65	3.33	2.57	1.30	0.73	0.07	0.85	1.46	0.64	2.99	0.38	1.27	0.49	1.36	4.53	1.24	1.80
RES RUBBISH	2.39	1.66	2.56	2.20	1.41	0.64	0.47	0.05	0.55	0.97	0.53	2.35	0.36	1.07	0.29	0.85	3.33	0.74	1.24
MIXED GARBAGE	3.12	1.37	3.46	3.22	2.46	1.26	0.67	0.07	0.69	1.23	0.54	2.65	0.34	1.23	0.41	1.25	4.20	0.93	1.74
STREET REFUSE	1.37	0.79	1.77	1.54	1.20	0.75	0.45	0.03	0.46	0.65	0.52	1.70	0.27	0.89	0.25	0.66	2.35	0.56	0.89
DEAD ANIMALS	3.72	1.94	3.55	3.55	2.57	1.35	0.63	0.11	1.14	1.62	0.73	3.33	0.61	0.96	0.61	1.52	4.59	1.20	2.09
ABANDON VEHIC	1.05	0.51	0.53	0.46	0.27	0.12	0.18	0.02	0.26	0.21	0.62	1.66	0.14	0.15	0.33	0.44	1.79	0.49	0.81
DEMOLITION	1.15	0.51	1.21	1.12	0.37	0.11	0.38	0.04	0.37	0.19	0.43	1.24	0.11	0.12	0.17	0.23	1.84	0.42	0.54
CONSTRUCTION	1.14	0.33	0.65	0.55	0.30	0.11	0.30	0.04	0.35	0.17	0.47	1.30	0.06	0.12	0.17	0.23	1.83	0.41	0.46
SPECIAL	3.53	1.65	3.20	2.80	2.11	1.27	0.45	0.06	0.70	1.22	0.77	2.90	0.73	1.34	0.52	1.49	3.72	1.15	1.56
SEWAGE TR SLDG	[illegible]	0.80	2.73	2.55	1.60	0.76	0.55	0.07	0.63	0.79	0.63	2.30	0.34	0.90	0.27	0.76	3.27	0.58	1.28
WATER TR SLDG	0.91	0.62	0.73	0.62	0.40	0.10	0.32	0.05	0.45	0.65	0.51	1.34	0.37	0.78	0.22	0.33	1.37	0.32	0.55
ASHES	0.64	0.33	0.56	0.33	0.32	0.09	0.47	0.02	0.47	0.45	0.25	0.58	0.12	0.22	0.22	0.26	0.89	0.45	0.63
GRAN FEEDS	3.43	1.74	3.38	3.24	2.38	1.15	0.96	0.13	0.97	1.34	0.91	2.59	0.54	1.24	0.56	1.15	4.06	1.15	1.75
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARLEY	0.93	0.74	[illegible]	0.90	0.59	0.04	0.13	0.00	0.47	0.67	0.52	1.23	0.24	0.50	0.13	0.24	1.44	0.33	0.47
BEANS DRY	0.73	0.70	1.01	0.94	0.50	0.05	0.15	0.00	0.42	0.71	0.55	1.39	0.24	0.53	0.18	0.23	1.60	0.32	0.42
CORN	1.23	0.75	1.71	1.60	0.50	0.05	0.15	0.00	0.42	0.71	0.55	1.64	0.24	0.53	0.18	0.23	2.30	0.32	0.42
COTTON LINT	0.50	0.67	0.97	0.83	0.34	0.34	0.15	0.00	0.42	0.51	0.52	1.30	0.23	0.53	0.13	0.23	1.46	0.32	0.41
COTTON SEED	0.73	0.70	1.01	0.94	0.50	0.05	0.16	0.00	0.42	0.71	0.55	1.38	0.24	0.53	0.18	0.23	1.60	0.32	0.42
HAY	0.73	0.70	1.01	0.94	0.50	0.05	0.16	0.00	0.42	0.71	0.55	1.38	0.24	0.53	0.13	0.23	1.60	0.32	0.42
OATS	[illegible]	0.84	1.67	0.53	0.60	0.03	0.16	0.00	0.47	0.76	0.55	1.45	0.26	0.54	0.19	0.23	1.65	0.32	0.47
ALFALFA	1.02	0.76	1.77	1.50	1.17	0.47	0.16	0.00	0.47	0.76	0.55	1.57	0.26	0.54	0.19	0.23	2.36	0.32	0.47
RICE	0.93	0.55	0.90	[illegible]	0.59	0.04	0.15	0.00	0.47	0.67	0.52	1.25	0.24	0.50	0.18	0.23	1.44	0.31	0.47
SAFFLOWER	0.73	0.70	1.01	0.94	0.50	0.05	0.16	0.00	0.42	0.71	0.55	1.38	0.24	0.53	0.18	0.23	1.60	0.32	0.42
SORGHUM	0.73	0.70	1.01	0.94	0.50	0.05	0.16	0.00	0.42	0.71	0.55	1.38	0.24	0.53	0.18	0.23	1.60	0.32	0.42
SUGAR BEETS	[illegible]	[illegible]	2.12	1.53	0.80	0.05	0.16	0.00	0.52	0.81	0.55	2.06	0.26	0.56	0.19	0.23	2.71	0.37	0.80
WHEAT	0.93	0.55	[illegible]	0.90	0.59	0.04	0.13	0.00	0.47	0.57	0.52	1.25	0.24	0.50	0.16	0.24	1.44	0.33	0.47
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEANS	1.40	0.55	1.47	1.42	1.09	0.14	0.64	0.06	0.74	1.09	0.55	1.55	0.21	0.82	0.29	0.36	2.21	0.56	0.66
CABBAGE	2.04	1.01	3.09	2.95	2.06	0.73	[illegible]	0.35	0.76	1.05	[illegible]	[illegible]	0.24	0.95	0.31	0.57	3.82	0.72	0.67
CHINESE VEGS	1.40	0.55	1.47	1.42	1.09	0.14	0.64	0.06	0.74	1.09	0.55	1.55	0.21	0.82	0.29	0.36	2.21	0.56	0.66
SWEET CORN	1.40	0.55	1.47	1.42	1.09	0.14	0.64	0.06	0.74	1.09	0.55	1.55	0.21	0.82	0.29	0.36	2.21	0.56	0.66
CUCUMBERS	1.40	0.55	1.47	1.42	1.09	0.14	0.64	0.06	0.74	1.09	0.55	1.55	0.21	0.82	0.29	0.36	2.21	0.56	0.66
MELONS	2.55	1.03	3.01	2.83	2.13	[illegible]	0.59	0.05	0.76	1.33	[illegible]	2.80	0.24	0.97	0.31	0.57	3.76	0.76	0.67
ONIONS	2.00	0.95	3.22	3.07	2.33	1.17	0.64	0.06	0.74	1.09	0.55	2.43	0.21	0.82	0.29	0.84	3.96	0.65	1.31
PEPPERS	1.40	0.55	1.47	1.42	1.09	0.14	0.64	0.06	0.74	1.09	0.55	1.55	0.21	0.82	0.29	0.36	2.21	0.56	0.66
RADISHES	1.40	0.55	1.47	1.42	1.09	0.14	0.64	0.06	0.74	1.09	0.55	1.55	0.21	0.82	0.29	0.36	2.21	0.56	0.66
ROMAINE	1.40	0.55	1.47	1.42	1.09	0.14	0.64	0.06	0.74	1.09	0.55	1.55	0.21	0.82	0.29	0.36	2.21	0.56	0.66
SQUASH	1.40	0.52	1.45	1.41	1.07	0.14	0.60	0.06	0.73	1.08	0.55	1.56	0.22	0.80	0.30	0.36	2.21	0.54	0.67
SWEET POTATOES	1.40	0.55	1.47	1.42	1.09	0.14	0.64	0.06	0.74	1.09	0.55	1.55	0.21	0.82	0.29	0.35	2.21	0.56	0.66
TOMATOES	[illegible]	1.00	3.15	3.31	2.26	1.05	0.59	0.35	0.80	1.37	[illegible]	2.88	0.25	0.97	0.33	0.73	3.90	0.78	0.72
TURNIPS	1.40	0.55	1.47	1.42	1.09	0.14	0.64	0.06	0.74	1.09	0.55	1.55	0.21	0.82	0.29	0.35	2.21	0.56	0.66
VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table IV-8 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION CONSIDERED POSSIBLE

SUB REGION MUNICIPAL

	UNMAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMPST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALMONDS	0.77	0.53	0.64	0.76	0.56	0.03	0.09	0.00	0.43	0.79	0.51	1.15	0.13	0.64	0.23	0.28	1.26	0.40	0.64
APRICOTS	1.82	0.64	2.46	2.29	1.42	0.69	0.38	0.02	0.57	0.89	0.46	2.13	0.13	0.64	0.26	0.48	2.90	0.50	0.61
BUSHBERRIES	0.87	0.55	0.99	0.91	0.50	0.06	0.32	0.02	0.51	0.84	0.48	1.18	0.13	0.64	0.26	0.32	1.45	0.45	0.61
FIGS	1.67	0.76	2.23	2.08	1.09	0.38	0.35	0.02	0.57	0.91	0.46	1.79	0.21	0.67	0.26	0.41	2.68	0.52	0.75
GRAPEFRUIT	1.47	0.59	2.03	1.88	0.73	0.27	0.27	0.02	0.50	0.83	0.48	1.73	0.19	0.63	0.26	0.33	2.51	0.43	0.62
GRAPES	1.58	0.62	2.28	2.12	1.46	0.75	0.38	0.02	0.51	0.84	0.48	2.16	0.13	0.64	0.25	0.53	2.72	0.48	0.61
LEMONS	1.45	0.57	2.03	1.88	0.73	0.27	0.27	0.02	0.49	0.83	0.45	1.75	0.13	0.63	0.26	0.33	2.51	0.43	0.62
NECTARINES	1.60	0.75	2.63	2.45	1.53	0.72	0.38	0.02	0.56	0.86	0.54	2.08	0.20	0.79	0.26	0.37	3.04	0.52	0.61
OLIVES	0.87	0.55	0.99	0.91	0.50	0.06	0.32	0.02	0.51	0.84	0.47	1.16	0.18	0.64	0.26	0.32	1.45	0.45	0.61
ORANGES	1.47	0.67	2.08	1.54	1.00	0.42	0.27	0.02	0.53	0.88	0.45	1.38	0.21	0.66	0.25	0.38	2.57	0.48	0.68
PEACHES	2.11	0.86	3.00	2.80	1.81	0.83	0.42	0.02	0.61	0.93	0.54	2.53	0.23	0.80	0.23	0.63	3.44	0.69	0.68
PERSIMMONS	0.87	0.55	0.99	0.91	0.50	0.06	0.32	0.02	0.51	0.84	0.43	1.18	0.13	0.64	0.26	0.32	1.45	0.45	0.61
PLUMS	1.77	0.66	2.68	2.49	1.48	0.66	0.38	0.02	0.57	0.87	0.54	2.32	0.20	0.79	0.26	0.51	3.08	0.52	0.61
POMEGRANATES	0.87	0.55	0.99	0.91	0.50	0.06	0.32	0.02	0.51	0.84	0.48	1.16	0.13	0.64	0.26	0.32	1.45	0.45	0.61
STRAWBERRIES	0.87	0.55	0.99	0.91	0.50	0.06	0.39	0.02	0.68	1.03	0.46	1.16	0.13	0.76	0.27	0.32	1.59	0.45	0.64
WALNUTS	1.07	0.60	1.54	1.42	0.56	0.03	0.09	0.00	0.45	0.79	0.54	1.18	0.15	0.64	0.23	0.23	1.96	0.46	0.64
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CATTLE MANURE	3.32	1.31	3.64	3.34	2.04	0.81	0.58	0.08	0.89	1.18	0.62	2.79	0.43	1.14	0.36	1.31	4.19	0.82	1.48
SHEEP MANURE	1.64	0.98	2.29	2.04	1.06	0.44	0.54	0.07	0.68	1.01	0.56	1.89	0.41	1.06	0.35	0.83	2.77	0.61	1.02
HOG MANURE	2.92	1.08	3.14	2.83	1.59	0.84	0.52	0.10	0.71	1.03	0.56	2.77	0.40	1.08	0.35	1.25	3.53	0.79	1.19
HORSE MANURE	2.37	0.98	3.04	2.74	1.59	0.80	0.51	0.07	0.68	1.01	0.55	2.48	0.39	1.09	0.35	1.04	3.47	0.72	1.09
CHICK MANURE	2.50	0.92	3.07	2.83	1.77	0.88	0.55	0.07	0.70	1.03	0.58	2.91	0.36	1.15	0.34	1.22	3.66	0.80	1.49
TURKEY MANURE	1.75	0.96	2.39	2.13	1.29	0.57	0.52	0.07	0.70	1.01	0.55	2.18	0.40	1.09	0.34	0.91	2.79	0.64	1.02
PIGEON MANURE	2.19	0.99	2.46	2.20	1.52	0.69	0.49	0.07	0.67	0.98	0.55	2.43	0.40	1.09	0.34	0.81	3.01	0.71	0.97
RABBIT MANURE	2.26	0.98	2.58	2.51	1.46	0.65	0.51	0.07	0.68	1.02	0.56	2.51	0.40	1.09	0.34	0.38	2.98	0.74	1.12
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON TRASH	1.51	0.62	1.44	1.36	0.73	0.50	0.37	0.03	0.58	0.80	0.54	1.71	0.23	0.66	0.19	0.39	2.18	0.52	0.61
FRUIT AND VEG	2.08	0.90	3.38	3.07	2.03	0.50	0.42	0.05	0.69	1.05	0.60	3.11	0.45	1.19	0.34	0.87	3.92	0.59	0.99
POULTRY	3.57	1.58	3.58	3.37	2.45	1.22	0.71	0.12	0.98	1.40	0.82	3.24	0.41	1.54	0.45	1.10	4.31	0.94	1.48
ANIMAL	3.61	1.59	3.70	3.42	2.46	1.22	0.73	0.13	0.96	1.42	0.79	3.71	0.41	1.57	0.41	1.06	4.26	0.99	1.37
MILK SOLIDS	2.01	0.82	2.04	1.78	1.62	0.77	0.47	0.05	0.73	1.04	0.71	2.13	0.51	1.26	0.21	0.53	2.58	0.45	0.86
SPIRITS	2.37	0.98	2.74	2.50	1.78	0.85	0.38	0.08	0.58	1.09	0.59	2.57	0.37	0.97	0.33	0.76	3.27	0.65	0.88
VEGET OILS	1.70	0.59	2.49	2.35	1.52	0.55	0.26	0.02	0.36	0.97	0.40	1.63	0.24	0.77	0.25	0.84	2.81	0.46	0.52
TALLOW	2.95	1.28	3.05	2.77	1.96	1.15	0.48	0.07	0.55	1.13	0.55	2.59	0.43	1.24	0.30	0.98	3.70	0.81	1.13
TEXTILES	0.96	0.32	0.82	0.63	0.15	0.05	0.13	0.02	0.39	0.33	0.35	1.30	0.22	0.31	0.04	0.05	1.27	0.22	0.24
WOOD PRODUCTS	0.92	0.53	0.97	0.81	0.16	0.02	0.18	0.0	0.39	0.37	0.40	0.47	0.26	0.44	0.09	0.12	1.55	0.20	0.25
CHEMICALS	1.37	1.45	1.52	1.17	0.57	0.20	0.61	0.04	0.85	1.54	0.78	1.79	0.77	1.51	0.09	0.92	1.83	1.02	1.14
PETROLEUM	1.50	1.27	1.28	1.10	0.60	0.17	0.52	0.02	0.72	1.27	0.56	1.74	0.43	1.45	0.59	0.83	1.66	0.89	1.11
PLASTICS	0.09	0.47	0.37	0.24	0.15	0.05	0.13	0.02	0.51	0.85	0.72	1.95	0.40	0.68	0.26	0.37	1.46	0.39	0.52
MASONRY	1.04	0.46	1.09	1.00	0.24	0.05	0.24	0.03	0.37	0.29	0.06	0.23	0.15	0.17	0.10	0.14	1.27	0.25	0.45
METALS	1.15	0.34	1.17	1.03	0.37	0.11	0.28	0.05	0.27	0.53	0.11	0.51	0.16	0.47	0.25	0.38	1.42	0.46	0.67
SEEDS	2.03	0.72	2.49	2.17	1.24	0.23	0.20	0.02	0.54	1.01	0.25	1.55	0.19	1.33	0.41	0.75	3.02	0.51	0.79
TIRES	1.19	0.48	1.05	1.02	0.74	0.05	0.13	0.01	0.54	0.12	0.01	1.55	0.17	0.15	0.12	0.20	1.67	0.29	0.47

Table IV-8 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION CONSIDERED POSSIBLE

SUB REGION INTERFACE

	UNMAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
GARBAGE	4.05	1.79	4.00	3.60	2.69	1.40	0.70	0.06	0.94	1.87	0.69	3.13	0.48	1.70	0.76	1.69	5.14	1.63	2.30
RES RUBBISH	2.52	1.42	2.82	2.36	1.53	0.69	0.46	0.04	0.67	1.24	0.60	2.54	0.46	1.42	0.49	1.09	3.80	1.07	1.65
MIXED GARBAGE	3.36	1.82	3.86	3.46	2.53	1.23	0.66	0.05	0.79	1.59	0.59	2.84	0.36	1.72	0.69	1.56	4.75	1.30	2.30
STREET REFUSE	2.40	1.29	2.16	1.77	1.30	0.78	0.47	0.03	0.58	0.83	0.56	1.94	0.39	1.26	0.46	0.83	2.84	0.84	1.24
DEAD ANIMALS	4.23	2.35	4.15	3.71	2.94	1.51	0.78	0.07	1.13	1.91	0.77	3.55	0.73	1.17	0.86	1.86	5.22	1.66	2.71
ABANDON VEHIC	1.45	0.60	0.75	0.61	0.31	0.16	0.17	0.01	0.31	0.34	0.61	1.78	0.16	0.19	0.53	0.72	2.28	0.73	1.30
DEMOLITION	1.37	0.35	1.46	1.29	0.51	0.16	0.37	0.03	0.47	0.30	0.49	1.48	0.09	0.12	0.30	0.39	2.25	0.66	0.87
CONSTRUCTION	1.51	0.90	0.92	0.77	0.47	0.15	0.35	0.03	0.43	0.29	0.50	1.50	0.07	0.12	0.30	0.39	2.22	0.66	0.74
SPECIAL	4.14	2.21	3.71	3.09	2.23	1.32	0.45	0.05	0.92	1.62	0.89	3.31	1.07	2.02	0.97	1.94	4.45	1.68	2.21
SEWAGE TR SLDG	3.26	1.14	2.90	2.75	1.71	0.79	0.51	0.04	0.68	1.00	0.65	2.50	0.39	1.16	0.45	0.98	3.74	0.82	1.74
WATER TR SLDG	1.21	0.73	0.91	0.71	0.40	0.16	0.31	0.03	0.46	0.81	0.53	1.42	0.39	1.00	0.35	0.47	1.64	0.44	0.87
ASHES	0.95	0.74	0.79	0.68	0.35	0.08	0.50	0.01	0.47	0.54	0.29	0.72	0.15	0.29	0.34	0.40	1.22	0.70	1.06
HUMAN FECES	4.21	2.30	4.07	3.55	2.53	1.17	0.93	0.11	1.03	1.92	0.99	3.19	0.75	1.67	0.82	1.43	4.79	1.53	2.25
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARLEY	1.30	1.00	1.24	1.09	0.67	0.07	0.17	0.00	0.57	0.88	0.59	1.52	0.34	0.77	0.34	0.41	1.83	0.58	0.75
BEANS DRY	1.29	1.02	1.27	1.12	0.65	0.08	0.21	0.00	0.52	0.92	0.62	1.66	0.34	0.80	0.34	0.41	1.99	0.58	0.70
CORN	1.59	1.02	1.97	1.78	0.65	0.08	0.21	0.00	0.52	0.92	0.62	1.92	0.34	0.80	0.34	0.41	2.69	0.58	0.70
COTTON LINT	1.22	0.91	1.21	1.07	0.62	0.08	0.19	0.00	0.51	0.81	0.59	1.65	0.33	0.80	0.32	0.40	1.84	0.55	0.69
COTTON SEED	1.27	1.00	1.25	1.11	0.65	0.09	0.21	0.00	0.50	0.90	0.62	1.66	0.34	0.80	0.33	0.40	1.97	0.56	0.70
HAY	1.29	1.02	1.27	1.12	0.65	0.08	0.21	0.00	0.52	0.92	0.62	1.66	0.34	0.80	0.34	0.41	1.99	0.58	0.70
OATS	1.37	1.10	1.33	1.18	0.73	0.08	0.21	0.00	0.57	0.97	0.62	1.73	0.36	0.81	0.35	0.41	2.04	0.58	0.75
ALFALFA	1.37	1.02	2.03	2.16	1.25	0.51	0.21	0.00	0.57	0.97	0.62	1.86	0.35	0.81	0.35	0.41	2.74	0.58	0.75
RICE	1.30	0.92	1.24	1.09	0.67	0.06	0.17	0.00	0.57	0.88	0.59	1.52	0.33	0.77	0.34	0.40	1.83	0.57	0.75
SAFFLOWER	1.29	1.02	1.27	1.12	0.65	0.08	0.21	0.00	0.52	0.92	0.62	1.66	0.34	0.80	0.34	0.41	1.99	0.58	0.70
SORGHUM	1.29	1.02	1.27	1.12	0.65	0.08	0.21	0.00	0.52	0.92	0.62	1.65	0.34	0.80	0.34	0.41	1.99	0.58	0.70
SUGAR BEETS	1.97	1.02	2.38	2.16	0.73	0.09	0.21	0.00	0.62	1.02	0.62	2.35	0.36	0.82	0.35	0.41	3.09	0.62	1.08
WHEAT	1.30	0.92	1.24	1.09	0.67	0.08	0.17	0.00	0.57	0.88	0.59	1.52	0.34	0.77	0.34	0.41	1.83	0.58	0.75
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEANS	1.70	1.20	1.67	1.53	1.12	0.16	0.58	0.04	0.81	1.21	0.59	1.76	0.29	1.14	0.47	0.56	2.54	0.84	0.99
CABBAGE	2.32	1.25	3.26	3.03	2.04	0.80	0.54	0.04	0.81	1.19	0.62	2.78	0.31	1.20	0.48	0.75	4.13	0.98	0.99
CHINESE VEGS	1.70	1.20	1.67	1.53	1.12	0.16	0.58	0.04	0.81	1.21	0.59	1.76	0.29	1.14	0.47	0.56	2.54	0.84	0.99
SWEET CORN	1.70	1.20	1.67	1.53	1.12	0.16	0.58	0.04	0.81	1.21	0.59	1.76	0.29	1.14	0.47	0.56	2.54	0.84	0.99
CUCUMBERS	1.70	1.20	1.67	1.53	1.12	0.16	0.58	0.04	0.81	1.21	0.59	1.76	0.29	1.14	0.47	0.56	2.54	0.84	0.99
MELONS	2.83	1.30	3.18	2.96	2.09	0.95	0.52	0.04	0.81	1.18	0.62	2.93	0.32	1.22	0.49	0.76	4.07	1.02	0.99
ONIONS	2.30	1.20	3.42	3.18	2.41	1.21	0.58	0.04	0.81	1.21	0.59	2.53	0.29	1.14	0.47	1.04	4.29	0.93	1.63
PEPPERS	1.70	1.20	1.67	1.53	1.12	0.16	0.58	0.04	0.81	1.21	0.59	1.76	0.29	1.14	0.47	0.56	2.54	0.84	0.99
RADISHES	1.70	1.20	1.67	1.53	1.12	0.16	0.58	0.04	0.81	1.21	0.59	1.76	0.29	1.14	0.47	0.56	2.54	0.84	0.99
ROMAINE	1.70	1.20	1.67	1.53	1.12	0.16	0.58	0.04	0.81	1.21	0.59	1.76	0.29	1.14	0.47	0.56	2.54	0.84	0.99
SQUASH	1.70	1.17	1.65	1.52	1.10	0.16	0.54	0.04	0.80	1.20	0.68	1.79	0.30	1.12	0.48	0.57	2.54	0.82	0.99
SWEET POTATOES	1.70	1.20	1.67	1.53	1.12	0.16	0.58	0.04	0.81	1.21	0.59	1.76	0.29	1.14	0.47	0.56	2.54	0.84	0.99
TOMATOES	3.14	1.29	3.32	3.10	2.26	1.08	0.54	0.04	0.83	1.19	0.62	3.02	0.32	1.22	0.48	0.96	4.21	0.99	1.04
TURNIPS	1.70	1.20	1.67	1.53	1.12	0.16	0.58	0.04	0.81	1.21	0.59	1.76	0.29	1.14	0.47	0.56	2.54	0.84	0.99
VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table IV-8 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION CONSIDERED POSSIBLE

SUB REGION INTERFACE

	UNMAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALMONDS	1.19	0.84	1.14	0.99	0.70	0.08	0.13	0.00	0.51	1.07	0.63	1.49	0.27	0.97	0.41	0.50	1.72	0.69	1.04
APRICOTS	2.17	0.94	2.70	2.45	1.53	0.73	0.37	0.01	0.62	1.12	0.54	2.35	0.27	0.97	0.42	0.68	3.34	0.76	1.00
BUSHBERRIES	1.24	0.86	1.25	1.11	0.64	0.09	0.32	0.01	0.58	1.09	0.54	1.41	0.27	0.97	0.43	0.53	1.92	0.74	1.00
FIGS	2.01	1.06	2.46	2.24	1.19	0.41	0.34	0.01	0.62	1.15	0.54	2.02	0.29	1.00	0.42	0.61	3.12	0.78	1.14
GRAPEFRUIT	1.85	0.90	2.29	2.08	0.87	0.30	0.27	0.01	0.57	1.08	0.54	1.96	0.28	0.96	0.43	0.53	2.98	0.72	1.01
GRAPES	1.93	0.92	2.52	2.29	1.57	0.79	0.37	0.01	0.57	1.08	0.54	2.33	0.27	0.98	0.42	0.73	3.17	0.75	1.00
LEMONS	1.83	0.68	2.29	2.08	0.87	0.30	0.27	0.01	0.56	1.08	0.54	1.96	0.28	0.96	0.43	0.53	2.98	0.72	1.01
NECTARINES	2.14	1.05	2.84	2.59	1.59	0.75	0.37	0.01	0.61	1.10	0.57	2.25	0.28	1.05	0.41	0.55	3.47	0.77	1.00
OLIVES	1.24	0.86	1.25	1.11	0.64	0.09	0.32	0.01	0.58	1.09	0.54	1.41	0.27	0.97	0.43	0.53	1.92	0.74	1.00
ORANGES	1.84	0.97	2.34	2.13	1.13	0.47	0.27	0.01	0.59	1.12	0.54	2.12	0.30	0.99	0.42	0.59	3.04	0.75	1.06
PEACHES	2.42	1.06	3.18	2.91	1.86	0.90	0.39	0.01	0.64	1.16	0.57	2.08	0.31	1.06	0.43	0.82	3.84	0.90	1.06
PERSIMMONS	1.24	0.86	1.25	1.11	0.64	0.09	0.32	0.01	0.58	1.09	0.54	1.41	0.27	0.97	0.43	0.53	1.92	0.74	1.00
PLUMS	2.10	0.96	2.87	2.62	1.53	0.69	0.37	0.01	0.62	1.11	0.57	2.46	0.28	1.05	0.41	0.70	3.50	0.77	1.00
POMEGRANATES	1.24	0.86	1.25	1.11	0.64	0.09	0.32	0.01	0.58	1.09	0.54	1.41	0.27	0.97	0.43	0.53	1.92	0.74	1.00
STRAWBERRIES	1.24	0.85	1.25	1.11	0.63	0.11	0.39	0.01	0.73	1.31	0.54	1.42	0.27	1.09	0.43	0.53	2.04	0.72	1.03
WALNUTS	1.50	0.92	1.85	1.66	0.71	0.08	0.14	0.00	0.54	1.09	0.66	1.52	0.27	0.97	0.42	0.51	2.43	0.75	1.04
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CATTLE MANURE	3.78	1.66	3.94	3.45	2.06	0.84	0.54	0.06	0.91	1.41	0.65	3.06	0.56	1.54	0.55	1.49	4.58	1.10	1.91
SHEEP MANURE	2.18	1.38	2.65	2.22	1.13	0.48	0.52	0.06	0.74	1.25	0.59	1.99	0.53	1.48	0.54	1.09	3.25	0.92	1.47
HOG MANURE	3.40	1.45	3.47	2.98	1.66	0.85	0.50	0.07	0.75	1.27	0.59	2.87	0.53	1.49	0.54	1.43	4.02	1.07	1.62
HORSE MANURE	2.90	1.38	3.39	2.91	1.68	0.83	0.51	0.06	0.74	1.25	0.59	2.58	0.53	1.50	0.54	1.25	3.95	1.03	1.55
CHICK MANURE	3.36	1.27	3.37	2.98	1.84	0.90	0.54	0.06	0.75	1.36	0.63	3.03	0.45	1.60	0.60	1.43	4.14	1.12	1.98
TURKEY MANURE	2.26	1.36	2.73	2.29	1.36	0.69	0.51	0.06	0.75	1.25	0.59	2.27	0.53	1.50	0.53	1.10	3.26	0.94	1.48
PIGEON MANURE	2.74	1.39	2.82	2.37	1.61	0.73	0.50	0.06	0.74	1.24	0.59	2.53	0.53	1.50	0.53	1.03	3.50	1.02	1.43
RABBIT MANURE	2.81	1.38	2.94	2.48	1.53	0.69	0.51	0.06	0.74	1.27	0.59	2.61	0.53	1.50	0.53	1.09	3.47	1.04	1.57
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON TRASH	1.53	0.83	1.56	1.42	0.75	0.32	0.33	0.02	0.56	1.01	0.62	1.84	0.36	1.20	0.35	0.59	2.56	0.85	1.02
FRUIT AND VEG	3.29	1.30	3.64	3.19	2.06	0.82	0.39	0.03	0.69	1.30	0.62	3.20	0.59	1.62	0.51	1.09	4.34	0.78	1.43
POULTRY	4.10	1.95	3.87	3.52	2.50	1.22	0.64	0.10	0.99	1.74	0.86	3.47	0.52	2.08	0.70	1.39	4.67	1.26	2.08
ANIMAL	4.18	1.98	4.00	3.58	2.51	1.22	0.64	0.11	0.97	1.77	0.83	3.41	0.54	2.07	0.64	1.32	4.78	1.27	1.94
MILK SOLIDS	2.45	1.26	2.36	1.96	1.85	0.98	0.41	0.03	0.66	1.34	0.78	2.43	0.68	1.67	0.30	0.67	2.86	0.77	1.38
SPIRITS	2.85	1.27	2.93	2.55	1.75	0.86	0.33	0.06	0.59	1.36	0.63	2.69	0.43	1.30	0.50	0.95	3.60	0.91	1.27
VEGET OILS	1.99	0.89	2.68	2.48	1.54	0.59	0.26	0.01	0.38	1.24	0.44	1.83	0.29	1.04	0.43	1.09	3.30	0.81	0.91
TALLOW	3.46	1.68	3.33	2.94	2.03	1.20	0.43	0.06	0.55	1.31	0.60	2.80	0.53	1.75	0.45	1.22	4.23	1.09	1.65
TEXTILES	1.23	0.50	0.90	0.86	0.19	0.08	0.12	0.01	0.45	0.35	0.34	1.32	0.27	0.42	0.09	0.14	1.43	0.40	0.44
WOOD PRODUCTS	1.33	0.91	1.22	0.95	0.26	0.07	0.22	0.0	0.52	0.54	0.46	1.30	0.36	0.65	0.18	0.25	1.98	0.40	0.46
CHEMICALS	2.74	2.11	2.11	1.45	0.88	0.23	0.65	0.03	0.96	2.05	1.02	2.30	1.16	2.14	1.14	1.39	2.64	1.60	1.81
PETROLEUM	2.05	1.72	1.64	1.30	0.76	0.17	0.55	0.01	0.86	1.72	0.65	1.99	0.57	2.09	0.96	1.23	2.55	1.35	1.82
PLASTICS	1.24	0.87	0.63	0.42	0.25	0.07	0.16	0.01	0.67	1.18	0.84	2.28	0.53	1.38	0.45	0.69	2.05	0.73	0.90
MASONARY	1.37	0.74	1.26	1.08	0.28	0.09	0.24	0.02	0.47	0.42	0.09	0.42	0.20	0.27	0.21	0.36	1.55	0.42	0.76
METALS	1.69	0.98	1.52	1.26	0.60	0.20	0.37	0.06	0.29	0.75	0.18	0.69	0.19	0.78	0.44	0.70	1.90	0.80	1.12
SEEDS	2.67	1.33	2.95	2.43	1.41	0.32	0.31	0.02	0.67	1.42	0.36	1.75	0.31	1.57	0.74	1.15	3.67	0.94	1.33
TIRES	1.66	0.67	1.21	1.16	0.84	0.08	0.12	0.01	0.54	0.16	0.84	2.07	0.18	0.17	0.22	0.38	1.99	0.48	0.71

Table IV-8 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION CONSIDERED POSSIBLE

SUB REGION AGRICULTURAL

	UNMAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGUN	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
GARBAGE	5.35	2.39	5.13	4.43	3.06	1.42	0.57	0.04	1.53	2.77	0.59	2.95	0.70	2.42	1.47	2.34	6.49	2.57	3.10
RES RUBBISH	3.27	1.53	3.52	2.30	1.75	0.76	0.34	0.03	0.99	1.83	0.56	2.27	0.60	1.96	0.97	1.53	4.35	1.76	2.26
MIXED GARBAGE	4.43	2.35	4.51	3.39	2.75	1.26	0.50	0.04	1.03	2.26	0.45	2.46	0.43	2.40	1.30	2.10	5.28	2.07	3.03
STREET REFUSE	3.74	2.19	3.14	2.43	1.43	0.85	0.36	0.02	1.06	1.15	0.55	1.66	0.65	1.97	0.99	1.23	3.54	1.57	1.73
DEAD ANIMALS	5.30	2.75	4.06	3.59	2.97	1.46	0.51	0.04	1.36	2.30	0.64	3.32	0.98	1.53	1.60	2.56	6.18	2.49	3.52
ABANDON VEHIC	1.59	0.55	0.85	0.88	0.38	0.22	0.09	0.01	0.28	0.49	0.38	1.22	0.03	0.11	0.76	1.05	2.48	0.93	1.84
DEMOLITION	1.37	1.24	1.62	1.43	0.60	0.23	0.25	0.02	0.66	0.57	0.45	1.27	0.05	0.06	0.59	0.61	2.60	1.09	1.25
CONSTRUCTION	1.27	1.15	1.24	0.93	0.54	0.21	0.25	0.02	0.60	0.56	0.45	1.26	0.04	0.05	0.59	0.65	2.51	1.09	1.06
SPECIAL	5.01	3.02	4.55	3.65	2.49	1.35	0.43	0.04	1.50	2.41	1.03	3.34	1.91	3.29	1.90	2.84	5.74	2.76	3.24
SEWAGE TR SLDG	3.97	1.59	3.44	3.10	1.39	0.32	0.43	0.02	0.93	1.49	0.49	2.16	0.41	1.54	0.93	1.46	4.17	1.41	2.39
WATER TR SLDG	1.40	0.72	0.98	0.65	0.36	0.17	0.13	0.01	0.36	0.38	0.30	1.37	0.35	1.31	0.55	0.71	1.65	0.65	1.27
ASHES	0.87	0.60	0.69	0.51	0.22	0.07	0.24	0.00	0.30	0.42	0.13	0.50	0.16	0.32	0.49	0.60	1.31	1.02	1.56
HUMAN FECES	5.37	2.87	4.02	3.98	2.70	1.21	0.81	0.07	1.36	2.36	0.64	3.21	1.38	2.52	1.59	1.90	5.92	2.27	3.16
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARLEY	2.00	1.49	1.88	1.52	0.78	0.11	0.15	0.00	0.88	1.36	0.49	1.37	0.45	1.12	0.77	0.65	2.37	1.20	1.12
BEANS DRY	1.95	1.45	1.86	1.51	0.72	0.12	0.16	0.00	0.84	1.35	0.51	1.47	0.44	1.13	0.76	0.65	2.40	1.18	1.07
CORN	2.25	1.45	2.56	2.16	0.72	0.12	0.16	0.00	0.84	1.35	0.51	1.75	0.44	1.13	0.76	0.65	3.10	1.18	1.07
COTTON LINT	1.74	1.21	1.62	1.33	0.71	0.13	0.14	0.00	0.62	1.10	0.49	1.46	0.44	1.13	0.61	0.63	2.19	0.99	1.05
COTTON SEED	1.76	1.25	1.64	1.35	0.72	0.14	0.15	0.00	0.62	1.14	0.51	1.47	0.44	1.13	0.61	0.63	2.25	0.99	1.06
HAY	1.95	1.45	1.86	1.51	0.72	0.12	0.16	0.00	0.84	1.35	0.51	1.47	0.44	1.13	0.76	0.65	2.40	1.18	1.07
OATS	2.03	1.53	1.91	1.56	0.80	0.12	0.16	0.00	0.88	1.40	0.51	1.53	0.46	1.14	0.77	0.65	2.46	1.18	1.12
ALFALFA	2.03	1.45	2.61	2.55	1.32	0.54	0.15	0.00	0.86	1.40	0.51	1.66	0.45	1.14	0.77	0.65	3.16	1.18	1.12
RICE	2.00	1.41	1.88	1.52	0.78	0.12	0.15	0.00	0.88	1.36	0.49	1.37	0.45	1.12	0.77	0.65	2.37	1.18	1.12
SAFFLOWER	1.95	1.45	1.86	1.51	0.72	0.12	0.16	0.00	0.84	1.35	0.51	1.47	0.44	1.13	0.76	0.65	2.40	1.18	1.07
SORGHUM	1.95	1.45	1.86	1.51	0.72	0.12	0.16	0.00	0.84	1.35	0.51	1.47	0.44	1.13	0.76	0.65	2.40	1.18	1.07
SUGAR BEETS	2.03	1.45	2.96	2.55	0.80	0.12	0.16	0.00	0.93	1.45	0.51	2.15	0.46	1.15	0.77	0.65	3.51	1.23	1.44
WHEAT	2.00	1.41	1.88	1.52	0.78	0.12	0.15	0.00	0.88	1.36	0.49	1.37	0.45	1.12	0.77	0.65	2.37	1.20	1.12
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEANS	2.29	1.61	2.13	1.78	1.08	0.20	0.38	0.03	1.01	1.51	0.50	1.59	0.43	1.49	0.94	0.89	2.97	1.50	1.43
CABBAGE	2.39	1.67	3.70	3.26	1.99	0.83	0.36	0.03	1.01	1.51	0.51	2.53	0.43	1.50	0.94	1.06	4.55	1.64	1.43
CHINESE VEGS	2.29	1.61	2.13	1.78	1.08	0.20	0.38	0.03	1.01	1.51	0.50	1.59	0.43	1.49	0.94	0.89	2.97	1.50	1.43
SWEET CORN	2.29	1.61	2.13	1.78	1.08	0.20	0.38	0.03	1.01	1.51	0.50	1.59	0.43	1.49	0.94	0.89	2.97	1.50	1.43
CUCUMBERS	2.29	1.61	2.13	1.78	1.08	0.20	0.38	0.03	1.01	1.51	0.50	1.59	0.43	1.49	0.94	0.89	2.97	1.50	1.43
MELONS	3.40	1.72	3.63	3.19	2.04	0.99	0.35	0.03	1.01	1.50	0.51	2.67	0.43	1.51	0.94	1.06	4.48	1.68	1.44
ONIONS	2.83	1.61	3.62	3.42	2.36	1.25	0.36	0.03	1.01	1.51	0.50	2.37	0.43	1.49	0.94	1.37	4.72	1.59	2.08
PEPPERS	2.29	1.61	2.13	1.78	1.08	0.20	0.38	0.03	1.01	1.51	0.50	1.59	0.43	1.49	0.94	0.89	2.97	1.50	1.43
RADISHES	2.29	1.61	2.13	1.78	1.08	0.20	0.38	0.03	1.01	1.51	0.50	1.59	0.43	1.49	0.94	0.89	2.97	1.50	1.43
ROMAINE	2.29	1.61	2.13	1.78	1.08	0.20	0.38	0.03	1.01	1.51	0.50	1.59	0.43	1.49	0.94	0.89	2.97	1.50	1.43
SQUASH	2.29	1.59	2.12	1.77	1.08	0.20	0.36	0.03	1.01	1.51	0.51	1.51	0.43	1.48	0.94	0.89	2.97	1.49	1.43
SWEET POTATOES	2.29	1.61	2.13	1.78	1.08	0.20	0.38	0.03	1.01	1.51	0.50	1.59	0.43	1.49	0.94	0.89	2.97	1.50	1.43
TOMATOES	3.71	1.66	3.77	3.37	2.35	1.21	0.42	0.03	0.97	1.47	0.51	2.66	0.44	1.52	0.79	1.27	4.62	1.46	1.47
TURNIPS	2.29	1.61	2.13	1.78	1.08	0.20	0.38	0.03	1.01	1.51	0.50	1.59	0.43	1.49	0.94	0.89	2.97	1.50	1.43
VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table IV-8 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION CONSIDERED POSSIBLE

SUB REGION AGRICULTURAL

	UNMAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALMONDS	1.82	1.30	1.69	1.44	1.08	0.13	0.19	0.00	0.61	1.48	0.65	1.50	0.42	1.40	0.72	0.81	2.37	1.18	1.56
APRICOTS	2.67	1.30	3.09	2.76	1.84	0.82	0.30	0.01	0.65	1.47	0.46	2.17	0.40	1.39	0.72	0.97	3.95	1.20	1.51
BUSHBERRIES	1.67	1.31	1.77	1.52	1.05	0.14	0.34	0.01	0.73	1.60	0.46	1.24	0.40	1.39	0.84	0.83	2.64	1.31	1.53
FIGS	2.52	1.45	2.87	2.55	1.50	0.50	0.31	0.01	0.74	1.57	0.46	1.48	0.42	1.43	0.72	0.92	3.76	1.22	1.65
GRAPEFRUIT	2.47	1.37	2.81	2.50	1.31	0.35	0.32	0.01	0.77	1.59	0.47	1.77	0.40	1.38	0.84	0.83	3.70	1.30	1.53
GRAPES	2.43	1.33	2.92	2.60	1.89	0.38	0.34	0.01	0.69	1.51	0.46	2.19	0.40	1.40	0.72	1.04	3.81	1.18	1.51
LEMONS	2.47	1.36	2.81	2.50	1.31	0.35	0.32	0.01	0.76	1.59	0.47	1.77	0.40	1.38	0.84	0.83	3.70	1.30	1.53
NECTARINES	2.70	1.43	3.29	2.94	1.89	0.88	0.33	0.01	0.64	1.46	0.47	2.06	0.40	1.42	0.67	0.82	4.12	1.18	1.51
OLIVES	1.37	1.31	1.77	1.52	1.06	0.14	0.34	0.01	0.78	1.60	0.46	1.24	0.40	1.39	0.84	0.83	2.64	1.31	1.53
ORANGES	2.47	1.39	2.87	2.55	1.54	0.59	0.30	0.01	0.76	1.59	0.47	2.01	0.43	1.42	0.72	0.89	3.75	1.19	1.57
PEACHES	2.57	1.45	3.62	3.25	2.17	1.03	0.36	0.01	0.68	1.51	0.47	2.48	0.43	1.43	0.68	1.10	4.46	1.29	1.56
PERSIMMONS	1.67	1.31	1.77	1.52	1.06	0.14	0.34	0.01	0.78	1.60	0.46	1.24	0.40	1.39	0.84	0.83	2.64	1.31	1.53
PLUMS	2.59	1.32	3.24	2.90	1.78	0.79	0.31	0.01	0.65	1.47	0.47	2.26	0.40	1.42	0.67	0.98	4.10	1.17	1.51
POMEGRANATES	1.37	1.31	1.77	1.52	1.06	0.14	0.34	0.01	0.78	1.60	0.46	1.24	0.40	1.39	0.84	0.83	2.64	1.31	1.53
STRAWBERRIES	1.67	1.26	1.77	1.52	1.03	0.23	0.35	0.01	0.80	1.65	0.46	1.33	0.40	1.45	0.72	0.83	2.69	1.15	1.52
WALNUTS	2.24	1.47	2.50	2.21	1.20	0.14	0.27	0.00	0.80	1.66	0.67	1.54	0.42	1.40	0.84	0.83	3.18	1.38	1.57
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CATTLE MANURE	4.04	2.35	4.70	3.71	2.14	0.38	0.45	0.05	1.35	2.07	0.58	2.40	0.75	2.17	1.04	1.84	5.29	1.86	2.60
SHEEP MANURE	3.27	2.08	3.43	2.49	1.20	0.52	0.45	0.05	1.19	1.91	0.52	1.74	0.73	2.13	1.03	1.46	3.99	1.71	2.18
HOG MANURE	4.46	2.13	4.22	3.24	1.74	0.38	0.42	0.04	1.19	1.92	0.52	2.62	0.73	2.12	1.03	1.78	4.73	1.84	2.30
HORSE MANURE	3.99	2.08	4.17	3.18	1.77	0.88	0.44	0.05	1.19	1.91	0.52	2.33	0.72	2.13	1.03	1.62	4.69	1.81	2.24
CHICK MANURE	4.33	1.90	4.06	3.23	1.91	0.94	0.45	0.05	1.20	2.07	0.58	2.81	0.58	2.29	1.13	1.83	4.89	1.92	2.72
TURKEY MANURE	3.32	2.06	3.48	2.54	1.44	0.73	0.43	0.05	1.20	1.91	0.52	2.02	0.73	2.13	1.03	1.46	3.97	1.71	2.18
PIGEON MANURE	3.82	2.08	3.58	2.63	1.69	0.73	0.43	0.05	1.19	1.91	0.52	2.26	0.73	2.13	1.03	1.41	4.24	1.80	2.13
RABBIT MANURE	3.90	2.08	3.71	2.76	1.62	0.73	0.44	0.05	1.19	1.93	0.52	2.36	0.73	2.13	1.03	1.46	4.23	1.83	2.27
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON TRASH	1.93	1.02	1.76	1.44	0.76	0.35	0.27	0.00	0.58	1.38	0.53	1.56	0.44	1.37	0.63	0.85	2.85	1.38	1.52
FRUIT AND VEG	3.80	1.69	4.09	3.45	2.24	0.91	0.31	0.02	0.72	1.68	0.46	2.60	0.76	2.24	0.78	1.38	4.69	1.09	1.96
POULTRY	4.97	2.39	4.53	3.91	2.63	1.24	0.40	0.08	1.14	2.40	0.70	3.39	0.84	3.02	1.29	1.95	5.85	1.83	2.95
ANIMAL	5.09	2.43	4.62	3.96	2.72	1.24	0.45	0.09	1.12	2.42	0.67	3.26	0.84	3.01	1.19	1.83	5.71	1.78	2.75
MILK SOLIDS	2.81	1.62	2.63	2.05	1.82	1.01	0.27	0.02	0.41	1.54	0.64	2.16	0.86	2.25	0.37	0.82	2.82	1.18	2.05
SPIRITS	3.29	1.65	3.30	2.57	1.74	0.36	0.25	0.04	0.73	1.86	0.50	2.44	0.51	1.75	0.83	1.21	3.99	1.39	1.80
VEGET OILS	2.02	0.89	2.64	2.37	1.47	0.63	0.21	0.00	0.31	1.48	0.44	1.74	0.33	1.41	0.56	1.40	3.74	1.25	1.37
TALLOW	3.79	1.84	3.42	2.90	1.97	1.25	0.32	0.05	0.43	1.44	0.56	2.50	0.71	2.53	0.65	1.53	4.58	1.48	2.33
TEXTILES	1.33	0.44	0.86	0.81	0.19	0.11	0.06	0.00	0.37	0.25	0.19	0.42	0.31	0.57	0.12	0.19	1.29	0.54	0.63
WOOD PRODUCTS	1.69	1.26	1.55	1.14	0.26	0.11	0.15	0.0	0.73	0.85	0.39	1.16	0.46	0.87	0.40	0.42	2.26	0.76	0.65
CHEMICALS	4.34	3.16	3.17	1.89	1.10	0.25	0.55	0.02	1.69	3.25	1.35	2.84	2.09	3.40	2.32	2.48	4.13	2.89	2.82
PETROLEUM	3.00	2.52	2.36	1.62	0.82	0.18	0.45	0.00	1.44	2.76	0.66	1.89	0.91	3.28	1.71	1.94	3.61	2.32	2.82
PLASTICS	1.69	1.13	1.03	0.63	0.39	0.13	0.19	0.00	0.77	1.34	0.77	2.13	0.61	1.96	0.69	1.13	2.35	1.18	1.38
MASONARY	1.74	0.95	1.55	1.14	0.28	0.15	0.19	0.01	0.69	0.75	0.10	0.54	0.22	0.39	0.41	0.64	1.93	0.74	1.12
METALS	2.14	1.30	1.85	1.44	0.77	0.33	0.42	0.07	0.28	0.99	0.24	0.78	0.18	1.19	0.70	1.12	2.44	1.20	1.67
SEEDS	3.91	2.35	4.17	3.25	1.87	0.40	0.42	0.03	1.23	2.40	0.51	1.81	0.68	2.42	1.47	1.80	4.90	1.82	2.04
TIRES	1.94	1.04	1.48	1.41	1.06	0.13	0.09	0.01	0.33	0.17	0.63	1.68	0.09	0.15	3.29	0.98	1.97	0.64	0.98

Table IV-9

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION NOT CONSIDERED POSSIBLE

Sub Region Industrial

	DRAIN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
GARBAGE	2.88	0.81	3.27	3.11	2.44	1.53	0.52	0.06	0.54	0.52	0.27	2.15	0.10	0.25	0.10	0.99	3.46	0.69	1.22
RES RUBBISH	1.53	0.64	2.15	1.96	1.40	0.71	0.32	0.05	0.39	0.42	0.21	1.51	0.09	0.21	0.07	0.64	2.54	0.41	0.78
MIXED GARBAGE	2.49	0.85	3.04	2.89	2.36	1.34	0.49	0.06	0.47	0.47	0.25	1.84	0.11	0.21	0.07	0.91	3.21	0.55	1.14
STREET REFUSE	1.45	0.37	1.59	1.49	1.23	0.85	0.32	0.04	0.31	0.30	0.20	0.96	0.04	0.17	0.05	0.45	1.78	0.34	0.51
DEAD ANIMALS	3.00	1.30	3.38	3.20	2.56	1.56	0.53	0.08	0.74	0.69	0.31	2.48	0.23	0.30	0.15	1.03	3.47	0.54	1.20
ABANDON VEHIC	0.63	0.34	0.40	0.36	0.24	0.13	0.13	0.02	0.18	0.11	0.30	0.95	0.08	0.08	0.07	0.09	0.95	0.25	0.22
DEMOLITION	0.77	0.39	0.66	0.85	0.31	0.12	0.28	0.04	0.22	0.12	0.17	0.63	0.06	0.07	0.06	0.09	1.07	0.23	0.21
CONSTRUCTION	0.75	0.37	0.48	0.45	0.30	0.11	0.26	0.04	0.20	0.11	0.19	0.66	0.04	0.07	0.06	0.09	1.07	0.22	0.21
SPECIAL	2.47	0.91	2.78	2.62	2.04	1.42	0.27	0.04	0.47	0.47	0.30	1.37	0.13	0.18	0.08	0.98	2.86	0.50	0.72
SEWAGE TR SLDG	2.55	0.44	2.57	2.44	1.57	0.81	0.31	0.04	0.35	0.28	0.29	1.65	0.11	0.19	0.05	0.46	2.68	0.27	0.77
WATER TR SLDG	0.39	0.31	0.34	0.33	0.21	0.10	0.17	0.02	0.25	0.20	0.25	0.69	0.14	0.17	0.04	0.09	0.59	0.12	0.11
ASHES	0.36	0.30	0.33	0.32	0.19	0.05	0.26	0.01	0.27	0.24	0.16	0.36	0.04	0.07	0.05	0.06	0.36	0.13	0.09
HUMAN FECES	2.05	1.03	3.05	2.88	2.19	1.19	0.62	0.10	0.63	0.71	0.33	2.05	0.16	0.27	0.14	0.72	3.08	0.70	1.17
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARLEY	0.54	0.41	0.59	0.58	0.39	0.03	0.07	0.00	0.28	0.27	0.22	0.59	0.06	0.06	0.03	0.04	0.73	0.07	0.09
BEANS DRY	0.51	0.40	0.60	0.59	0.36	0.03	0.09	0.00	0.25	0.29	0.24	0.69	0.05	0.07	0.03	0.04	0.80	0.06	0.05
CORN	0.88	0.40	1.42	1.38	0.36	0.03	0.09	0.00	0.25	0.29	0.24	0.99	0.05	0.07	0.03	0.04	1.62	0.06	0.05
COTTON LINT	0.45	0.35	0.58	0.57	0.35	0.03	0.08	0.00	0.25	0.24	0.22	0.68	0.05	0.08	0.03	0.04	0.73	0.06	0.05
COTTON SEED	0.51	0.40	0.60	0.59	0.36	0.03	0.09	0.00	0.25	0.29	0.24	0.69	0.05	0.07	0.03	0.04	0.80	0.06	0.05
HAY	0.51	0.40	0.60	0.59	0.36	0.03	0.09	0.00	0.25	0.29	0.24	0.69	0.05	0.07	0.03	0.04	0.80	0.06	0.05
OATS	0.53	0.47	0.64	0.63	0.43	0.03	0.09	0.00	0.28	0.32	0.24	0.74	0.07	0.08	0.03	0.04	0.85	0.06	0.09
ALFALFA	0.58	0.40	1.46	1.79	1.04	0.53	0.09	0.00	0.28	0.32	0.24	0.94	0.06	0.08	0.03	0.04	1.67	0.06	0.09
RICE	0.54	0.35	0.59	0.58	0.39	0.03	0.07	0.00	0.28	0.27	0.22	0.59	0.05	0.06	0.03	0.04	0.73	0.06	0.09
SAFFLOWER	0.51	0.40	0.60	0.59	0.36	0.03	0.09	0.00	0.25	0.29	0.24	0.69	0.05	0.07	0.03	0.04	0.80	0.06	0.05
SORGHUM	0.51	0.40	0.60	0.59	0.36	0.03	0.09	0.00	0.25	0.29	0.24	0.69	0.05	0.07	0.03	0.04	0.80	0.06	0.05
SUGAR BEETS	1.26	0.40	1.87	1.79	0.43	0.04	0.09	0.00	0.34	0.38	0.24	1.52	0.07	0.09	0.03	0.04	2.08	0.10	0.47
WHEAT	0.54	0.35	0.59	0.58	0.39	0.03	0.07	0.00	0.28	0.27	0.22	0.59	0.06	0.06	0.03	0.04	0.73	0.07	0.09
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEANS	0.82	0.56	0.90	0.93	0.81	0.12	0.47	0.05	0.46	0.54	0.25	0.87	0.04	0.21	0.07	0.10	1.26	0.22	0.20
CABBAGE	1.55	0.63	2.76	2.68	1.89	0.87	0.44	0.05	0.47	0.53	0.27	2.03	0.05	0.26	0.08	0.32	3.12	0.38	0.20
CHINESE VEGS	0.82	0.56	0.90	0.93	0.81	0.12	0.47	0.05	0.46	0.54	0.25	0.87	0.04	0.21	0.07	0.10	1.26	0.22	0.20
SWEET CORN	0.82	0.56	0.90	0.93	0.81	0.12	0.47	0.05	0.46	0.54	0.25	0.87	0.04	0.21	0.07	0.10	1.26	0.22	0.20
CUCUMBERS	0.82	0.56	0.90	0.93	0.81	0.12	0.47	0.05	0.46	0.54	0.25	0.87	0.04	0.21	0.07	0.10	1.26	0.22	0.20
MELONS	2.14	0.72	2.67	2.60	1.94	1.05	0.44	0.05	0.47	0.52	0.27	2.19	0.06	0.28	0.08	0.32	3.05	0.43	0.20
ONIONS	1.53	0.56	2.95	2.86	2.32	1.35	0.47	0.05	0.46	0.54	0.25	1.78	0.04	0.21	0.07	0.67	3.31	0.32	0.95
PEPPERS	0.82	0.56	0.90	0.93	0.81	0.12	0.47	0.05	0.46	0.54	0.25	0.87	0.04	0.21	0.07	0.10	1.26	0.22	0.20
RADISHES	0.82	0.56	0.90	0.93	0.81	0.12	0.47	0.05	0.46	0.54	0.25	0.87	0.04	0.21	0.07	0.10	1.26	0.22	0.20
ROMAINE	0.82	0.56	0.90	0.93	0.81	0.12	0.47	0.05	0.46	0.54	0.25	0.87	0.04	0.21	0.07	0.10	1.26	0.22	0.20
SQUASH	0.82	0.54	0.89	0.92	0.79	0.12	0.44	0.05	0.46	0.54	0.25	0.89	0.04	0.20	0.07	0.11	1.26	0.20	0.20
SWEET POTATOES	0.82	0.56	0.90	0.93	0.81	0.12	0.47	0.05	0.46	0.54	0.25	0.87	0.04	0.21	0.07	0.10	1.26	0.22	0.20
TOMATOES	2.50	0.68	2.84	2.76	2.13	1.19	0.44	0.05	0.48	0.53	0.27	2.29	0.06	0.28	0.09	0.56	3.21	0.42	0.26
TURNIPS	0.82	0.56	0.90	0.93	0.81	0.12	0.47	0.05	0.46	0.54	0.25	0.87	0.04	0.21	0.07	0.10	1.26	0.22	0.20
VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table IV-9 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION NOT CONSIDERED POSSIBLE

Sub Region Industrial

	UNMAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALMONDS	0.43	0.30	0.52	0.52	0.40	0.03	0.03	0.00	0.26	0.28	0.18	0.52	0.02	0.09	0.03	0.04	0.59	0.09	0.09
APRICOTS	1.60	0.42	2.35	2.23	1.44	0.73	0.27	0.01	0.36	0.35	0.20	1.73	0.02	0.09	0.04	0.24	2.37	0.17	0.06
BUSHBERRIES	0.46	0.30	0.60	0.59	0.33	0.04	0.18	0.01	0.30	0.29	0.20	0.61	0.02	0.09	0.04	0.06	0.63	0.11	0.06
FIGS	1.38	0.52	2.05	1.95	1.00	0.41	0.23	0.01	0.35	0.35	0.20	1.32	0.03	0.11	0.04	0.15	2.07	0.18	0.20
GRAPEFRUIT	1.16	0.36	1.82	1.73	0.62	0.29	0.15	0.01	0.29	0.28	0.20	1.24	0.02	0.08	0.04	0.06	1.87	0.10	0.07
GRAPES	1.31	0.38	2.13	2.02	1.48	0.85	0.27	0.01	0.30	0.29	0.20	1.69	0.02	0.09	0.04	0.30	2.15	0.14	0.06
LEMONS	1.15	0.35	1.82	1.73	0.62	0.29	0.15	0.01	0.28	0.28	0.20	1.24	0.02	0.08	0.04	0.06	1.87	0.10	0.07
NECTARINES	1.55	0.54	2.50	2.37	1.48	0.79	0.27	0.01	0.35	0.33	0.23	1.56	0.02	0.15	0.04	0.08	2.50	0.18	0.06
OLIVES	0.46	0.30	0.60	0.59	0.33	0.04	0.18	0.01	0.30	0.29	0.20	0.61	0.02	0.09	0.04	0.06	0.63	0.11	0.06
ORANGES	1.13	0.42	1.66	1.78	0.90	0.46	0.15	0.01	0.31	0.32	0.20	1.42	0.04	0.10	0.05	0.12	1.92	0.13	0.11
PEACHES	1.85	0.54	2.90	2.74	1.79	0.97	0.33	0.01	0.39	0.38	0.23	2.10	0.05	0.16	0.05	0.40	2.91	0.31	0.11
PERSIMMONS	0.46	0.30	0.60	0.59	0.33	0.04	0.18	0.01	0.30	0.29	0.20	0.61	0.02	0.09	0.04	0.06	0.63	0.11	0.06
PLUMS	1.52	0.44	2.56	2.43	1.44	0.72	0.27	0.01	0.36	0.34	0.23	1.64	0.02	0.15	0.04	0.25	2.56	0.18	0.06
POMEGRANATES	0.46	0.30	0.60	0.59	0.33	0.04	0.18	0.01	0.30	0.29	0.20	0.61	0.02	0.09	0.04	0.06	0.63	0.11	0.06
STRAWBERRIES	0.40	0.30	0.60	0.59	0.33	0.04	0.22	0.01	0.39	0.42	0.20	0.61	0.02	0.15	0.04	0.06	0.70	0.11	0.08
WALNUTS	0.78	0.39	1.34	1.29	0.40	0.03	0.05	0.00	0.27	0.28	0.20	0.55	0.02	0.09	0.03	0.04	1.41	0.13	0.09
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CATTLE MANURE	2.68	0.67	3.12	2.98	1.76	0.84	0.37	0.06	0.52	0.52	0.28	2.28	0.11	0.23	0.09	0.99	3.40	0.38	0.83
SHEEP MANURE	0.96	0.43	1.60	1.72	0.81	0.42	0.36	0.06	0.38	0.39	0.22	1.12	0.09	0.19	0.08	0.53	2.02	0.18	0.35
HOG MANURE	2.41	0.51	2.79	2.64	1.44	0.84	0.32	0.06	0.40	0.41	0.23	2.16	0.09	0.19	0.08	0.93	2.92	0.35	0.52
HORSE MANURE	1.81	0.43	2.68	2.54	1.45	0.84	0.34	0.06	0.38	0.39	0.22	1.81	0.09	0.20	0.08	0.72	2.84	0.31	0.44
CHICK MANURE	2.50	0.44	2.77	2.63	1.64	0.92	0.36	0.06	0.39	0.42	0.23	2.28	0.10	0.20	0.08	0.86	2.98	0.35	0.86
TURKEY MANURE	1.04	0.40	1.89	1.80	1.07	0.67	0.32	0.06	0.39	0.39	0.22	1.46	0.09	0.20	0.08	0.54	2.00	0.19	0.35
PIGEON MANURE	1.61	0.44	2.00	1.90	1.37	0.71	0.31	0.06	0.38	0.38	0.22	1.77	0.09	0.20	0.08	0.46	2.31	0.29	0.29
RABBIT MANURE	1.71	0.43	2.15	2.04	1.28	0.67	0.34	0.06	0.38	0.42	0.23	1.36	0.09	0.20	0.08	0.53	2.29	0.34	0.48
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON TRASH	1.06	0.30	1.25	1.19	0.59	0.30	0.18	0.01	0.30	0.24	0.21	0.91	0.07	0.14	0.04	0.13	1.48	0.12	0.07
FRUIT AND VEG	2.49	0.62	3.07	2.91	1.94	0.85	0.31	0.03	0.45	0.43	0.27	2.47	0.10	0.21	0.07	0.62	3.21	0.33	0.43
POULTRY	2.62	1.03	3.17	3.05	2.25	1.32	0.50	0.11	0.66	0.59	0.38	2.38	0.13	0.32	0.10	0.70	3.33	0.50	0.61
ANIMAL	2.80	1.66	3.24	3.07	2.25	1.32	0.50	0.12	0.63	0.59	0.36	2.41	0.13	0.30	0.09	0.68	3.32	0.57	0.56
MILK SOLIDS	1.51	0.31	1.69	1.60	1.87	1.06	0.22	0.02	0.43	0.59	0.31	1.60	0.11	0.23	0.07	0.44	1.97	0.08	0.16
SPIRITS	2.17	0.52	2.39	2.27	1.62	0.93	0.27	0.07	0.39	0.46	0.25	1.89	0.13	0.23	0.09	0.52	2.66	0.30	0.34
VEGET OILS	1.44	0.30	2.42	2.30	1.47	0.58	0.13	0.01	0.22	0.31	0.15	1.14	0.07	0.13	0.05	0.66	2.43	0.13	0.08
TALLOW	2.43	0.70	2.79	2.63	1.90	1.24	0.30	0.06	0.37	0.46	0.22	1.86	0.10	0.19	0.07	0.70	2.90	0.26	0.47
TEXTILES	0.17	0.22	0.50	0.58	0.09	0.04	0.07	0.01	0.23	0.20	0.18	0.70	0.06	0.06	0.04	0.05	0.83	0.09	0.06
WOOD PRODUCTS	0.47	0.22	0.59	0.56	0.10	0.02	0.10	0.0	0.23	0.15	0.17	0.49	0.06	0.09	0.03	0.05	0.89	0.08	0.07
CHEMICALS	0.63	0.52	0.58	0.55	0.33	0.11	0.30	0.02	0.43	0.47	0.24	0.68	0.13	0.23	0.11	0.18	0.56	0.26	0.16
PETROLEUM	0.53	0.52	0.58	0.55	0.35	0.10	0.27	0.01	0.38	0.40	0.22	0.83	0.14	0.22	0.11	0.18	0.64	0.26	0.16
PLASTICS	0.20	0.20	0.16	0.15	0.09	0.03	0.07	0.01	0.28	0.26	0.28	0.38	0.12	0.11	0.06	0.07	0.61	0.11	0.08
MASONARY	0.57	0.28	0.82	0.73	0.20	0.06	0.17	0.02	0.21	0.11	0.02	0.17	0.05	0.02	0.04	0.07	0.83	0.18	0.19
METALS	0.67	0.27	0.79	0.75	0.29	0.11	0.22	0.05	0.15	0.19	0.04	0.30	0.06	0.04	0.05	0.08	0.77	0.21	0.20
SEEDS	1.47	0.27	2.09	2.00	1.08	0.29	0.10	0.01	0.31	0.34	0.10	1.14	0.05	0.12	0.05	0.35	2.22	0.12	0.13
TIRES	0.31	0.32	0.85	0.82	0.61	0.05	0.11	0.01	0.30	0.09	0.36	0.93	0.10	0.09	0.06	0.07	1.10	0.17	0.22

Table IV-9 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION NOT CONSIDERED POSSIBLE

Sub Region Municipal

	UNMAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
GARBAGE	3.20	1.15	3.44	3.30	2.55	1.36	0.73	0.07	0.85	0.84	0.50	2.71	0.19	0.48	0.15	0.97	3.83	0.79	1.13
RES RUBBISH	1.81	0.87	2.39	2.14	1.40	0.64	0.46	0.05	0.55	0.63	0.38	2.06	0.17	0.37	0.09	0.62	2.87	0.46	0.74
MIXED GARBAGE	2.74	1.13	3.23	3.09	2.45	1.20	0.65	0.07	0.69	0.72	0.45	2.41	0.21	0.34	0.10	0.83	3.58	0.59	1.06
STREET REFUSE	1.52	0.55	1.60	1.55	1.20	0.73	0.44	0.03	0.46	0.45	0.35	1.46	0.07	0.29	0.06	0.44	1.96	0.33	0.47
DEAD ANIMALS	3.38	1.70	3.65	3.52	2.83	1.55	0.82	0.11	1.14	1.06	0.59	3.04	0.42	0.56	0.23	1.07	3.90	0.69	1.25
ABANDON VEHIC	0.81	0.41	0.47	0.43	0.27	0.12	0.17	0.02	0.26	0.11	0.57	1.58	0.14	0.15	0.10	0.13	1.32	0.30	0.25
DEMOLITION	1.03	0.56	1.16	1.12	0.39	0.11	0.37	0.04	0.37	0.19	0.32	1.07	0.11	0.12	0.07	0.12	1.53	0.25	0.20
CONSTRUCTION	1.00	0.53	0.61	0.53	0.36	0.11	0.35	0.04	0.35	0.17	0.36	1.13	0.06	0.12	0.07	0.12	1.51	0.24	0.21
SPECIAL	2.01	1.21	2.67	2.72	2.09	1.29	0.44	0.06	0.74	0.76	0.58	2.41	0.27	0.36	0.12	0.96	2.99	0.58	0.72
SEWAGE TR SLDG	2.55	0.76	2.65	2.54	1.65	0.78	0.52	0.07	0.63	0.51	0.53	2.11	0.22	0.36	0.07	0.50	2.85	0.35	0.73
WATER TR SLDG	0.63	0.55	0.59	0.58	0.39	0.16	0.32	0.05	0.45	0.35	0.46	1.22	0.27	0.33	0.06	0.14	1.06	0.17	0.17
ASHES	0.57	0.40	0.54	0.53	0.32	0.09	0.40	0.02	0.47	0.41	0.25	0.58	0.07	0.13	0.03	0.09	0.57	0.17	0.13
HUMAN FECES	2.92	1.40	3.24	3.10	2.30	1.15	0.94	0.13	0.96	1.03	0.72	2.55	0.29	0.51	0.24	0.77	3.33	0.78	1.13
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARLEY	0.61	0.64	0.69	0.68	0.59	0.04	0.15	0.00	0.47	0.46	0.41	1.00	0.10	0.11	0.04	0.07	1.13	0.10	0.13
BEANS DRY	0.79	0.60	0.93	0.92	0.56	0.05	0.16	0.00	0.42	0.50	0.45	1.16	0.10	0.13	0.04	0.06	1.29	0.09	0.08
CORN	1.09	0.60	1.63	1.57	0.50	0.05	0.16	0.00	0.42	0.50	0.45	1.42	0.10	0.13	0.04	0.06	1.99	0.09	0.08
COTTON LINT	0.74	0.57	0.88	0.87	0.54	0.04	0.15	0.00	0.42	0.41	0.41	1.13	0.09	0.14	0.03	0.06	1.15	0.09	0.07
COTTON SEED	0.79	0.66	0.93	0.92	0.50	0.03	0.16	0.00	0.42	0.50	0.45	1.16	0.10	0.13	0.04	0.06	1.29	0.09	0.08
HAY	0.79	0.60	0.93	0.92	0.50	0.05	0.16	0.00	0.42	0.50	0.45	1.16	0.10	0.13	0.04	0.06	1.29	0.09	0.08
OATS	0.88	0.75	0.98	0.97	0.60	0.05	0.16	0.00	0.47	0.55	0.45	1.23	0.12	0.14	0.04	0.06	1.35	0.09	0.14
ALFALFA	0.84	0.66	1.68	1.90	1.17	0.47	0.16	0.00	0.47	0.55	0.45	1.55	0.11	0.14	0.04	0.06	2.05	0.09	0.14
RICE	0.81	0.50	0.85	0.88	0.59	0.04	0.15	0.00	0.47	0.45	0.41	1.00	0.09	0.11	0.04	0.06	1.13	0.08	0.13
SAFFLOWER	0.79	0.66	0.93	0.92	0.56	0.05	0.16	0.00	0.42	0.50	0.45	1.16	0.10	0.13	0.04	0.06	1.29	0.09	0.08
SORGHUM	0.79	0.66	0.93	0.92	0.50	0.05	0.16	0.00	0.42	0.50	0.45	1.16	0.10	0.13	0.04	0.06	1.29	0.09	0.08
SUGAR BEETS	1.46	0.66	2.33	1.56	0.56	0.05	0.16	0.00	0.52	0.60	0.45	1.83	0.12	0.16	0.04	0.06	2.40	0.15	0.46
WHEAT	0.61	0.55	0.69	0.83	0.59	0.04	0.13	0.00	0.47	0.46	0.41	1.00	0.10	0.11	0.04	0.07	1.13	0.10	0.13
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEANS	1.25	0.85	1.38	1.40	1.09	0.14	0.64	0.06	0.74	0.88	0.44	1.32	0.07	0.33	0.10	0.13	1.82	0.28	0.24
CABBAGE	1.90	0.92	3.01	2.93	2.06	0.79	0.60	0.05	0.76	0.85	0.49	2.42	0.09	0.46	0.12	0.35	3.43	0.44	0.25
CHINESE VEGS	1.26	0.85	1.38	1.40	1.09	0.14	0.54	0.06	0.74	0.88	0.44	1.32	0.07	0.33	0.10	0.13	1.82	0.28	0.24
SWEET CORN	1.26	0.85	1.38	1.40	1.09	0.14	0.64	0.06	0.74	0.88	0.44	1.32	0.07	0.33	0.10	0.13	1.82	0.28	0.24
CUCUMBERS	1.26	0.85	1.38	1.40	1.09	0.14	0.64	0.06	0.74	0.88	0.44	1.32	0.07	0.33	0.10	0.13	1.82	0.28	0.24
MELONS	2.41	0.56	2.93	2.86	2.10	0.95	0.59	0.05	0.76	0.84	0.49	2.58	0.10	0.43	0.12	0.35	3.37	0.48	0.25
ONIONS	1.86	0.85	3.13	3.05	2.59	1.19	0.64	0.06	0.74	0.88	0.44	2.10	0.07	0.33	0.10	0.61	3.57	0.37	0.89
PEPPERS	1.26	0.85	1.38	1.40	1.09	0.14	0.64	0.06	0.74	0.88	0.44	1.32	0.07	0.33	0.10	0.13	1.82	0.28	0.24
RADISHES	1.26	0.85	1.38	1.40	1.09	0.14	0.64	0.06	0.74	0.88	0.44	1.32	0.07	0.33	0.10	0.13	1.82	0.28	0.24
ROMAINE	1.26	0.85	1.38	1.40	1.09	0.14	0.64	0.06	0.74	0.88	0.44	1.32	0.07	0.33	0.10	0.13	1.82	0.28	0.24
SQUASH	1.26	0.82	1.37	1.39	1.07	0.14	0.60	0.06	0.73	0.87	0.45	1.36	0.07	0.31	0.10	0.14	1.82	0.25	0.25
SWEET POTATOES	1.26	0.85	1.38	1.40	1.09	0.14	0.64	0.06	0.74	0.88	0.44	1.32	0.07	0.33	0.10	0.13	1.82	0.28	0.24
TOMATOES	2.72	0.96	3.07	2.99	2.26	1.06	0.59	0.05	0.80	0.86	0.49	2.65	0.10	0.48	0.13	0.56	3.51	0.50	0.30
TURNIPS	1.26	0.85	1.38	1.40	1.09	0.14	0.64	0.06	0.74	0.88	0.44	1.32	0.07	0.33	0.10	0.13	1.82	0.28	0.24
VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table IV-9 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION NOT CONSIDERED POSSIBLE

Sub Region Municipal

	UNMAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALMONDS	0.03	0.45	0.75	0.74	0.56	0.03	0.09	0.00	0.43	0.45	0.33	0.36	0.03	0.15	0.04	0.05	0.87	0.12	0.13
APRICOTS	1.66	0.55	2.38	2.27	1.42	0.69	0.38	0.02	0.57	0.55	0.37	1.96	0.04	0.15	0.06	0.26	2.44	0.22	0.11
BUSHBERRIES	0.73	0.45	0.91	0.89	0.50	0.06	0.32	0.02	0.51	0.50	0.37	1.01	0.04	0.15	0.06	0.09	0.98	0.17	0.11
FIGS	1.53	0.67	2.15	2.06	1.09	0.38	0.35	0.02	0.57	0.57	0.37	1.62	0.06	0.18	0.07	0.18	2.21	0.23	0.24
GRAPEFRUIT	1.33	0.49	1.94	1.86	0.73	0.27	0.27	0.02	0.50	0.48	0.37	1.56	0.05	0.13	0.07	0.10	2.05	0.15	0.11
GRAPES	1.44	0.52	2.20	2.10	1.46	0.75	0.38	0.02	0.51	0.50	0.37	1.93	0.04	0.15	0.06	0.30	2.26	0.20	0.11
LEMONS	1.31	0.48	1.94	1.86	0.73	0.27	0.27	0.02	0.49	0.48	0.37	1.56	0.05	0.13	0.07	0.10	2.05	0.15	0.11
NECTARINES	1.66	0.65	2.55	2.43	1.53	0.72	0.38	0.02	0.56	0.51	0.43	1.91	0.06	0.30	0.06	0.14	2.58	0.24	0.11
OLIVES	0.73	0.45	0.91	0.89	0.50	0.06	0.32	0.02	0.51	0.50	0.37	1.01	0.04	0.15	0.06	0.09	0.98	0.17	0.11
ORANGES	1.33	0.58	2.00	1.92	1.00	0.42	0.27	0.02	0.53	0.54	0.37	1.71	0.07	0.16	0.07	0.16	2.10	0.20	0.17
PEACHES	1.97	0.70	2.91	2.78	1.81	0.88	0.42	0.02	0.61	0.59	0.44	2.36	0.09	0.31	0.09	0.41	2.97	0.41	0.17
PERSIMMONS	0.73	0.45	0.91	0.89	0.50	0.06	0.32	0.02	0.51	0.50	0.37	1.01	0.04	0.15	0.06	0.09	0.98	0.17	0.11
PLUMS	1.55	0.57	2.59	2.47	1.48	0.66	0.38	0.02	0.57	0.52	0.43	2.15	0.06	0.30	0.05	0.28	2.62	0.24	0.11
POMEGRANATES	0.73	0.45	0.91	0.89	0.50	0.06	0.32	0.02	0.51	0.50	0.37	1.01	0.04	0.15	0.06	0.09	0.98	0.17	0.11
STRAWBERRIES	0.73	0.45	0.91	0.89	0.50	0.06	0.39	0.02	0.68	0.73	0.37	1.01	0.04	0.26	0.07	0.09	1.11	0.17	0.13
WALNUTS	0.93	0.50	1.45	1.40	0.56	0.03	0.09	0.00	0.45	0.45	0.36	0.90	0.03	0.15	0.04	0.05	1.57	0.17	0.13
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CATTLE MANURE	3.00	1.05	3.39	3.27	2.02	0.81	0.57	0.08	0.89	0.36	0.50	2.80	0.21	0.41	0.14	1.01	3.73	0.48	0.85
SHEEP MANURE	1.32	0.72	2.04	1.97	1.04	0.44	0.52	0.07	0.68	0.69	0.43	1.69	0.19	0.33	0.13	0.58	2.30	0.27	0.49
HOG MANURE	2.00	0.81	2.88	2.76	1.58	0.84	0.51	0.10	0.71	0.71	0.44	2.58	0.13	0.35	0.13	0.95	3.11	0.45	0.57
HORSE MANURE	2.05	0.72	2.78	2.66	1.38	0.80	0.49	0.07	0.68	0.69	0.43	2.29	0.17	0.36	0.13	0.74	3.00	0.38	0.47
CHICK MANURE	2.67	0.73	2.88	2.76	1.75	0.38	0.54	0.07	0.70	0.71	0.44	2.68	0.20	0.35	0.11	0.88	3.15	0.43	0.82
TURKEY MANURE	1.43	0.70	2.13	2.06	1.28	0.67	0.50	0.07	0.70	0.69	0.43	1.98	0.18	0.36	0.11	0.60	2.33	0.30	0.40
PIGEON MANURE	1.87	0.73	2.21	2.12	1.51	0.69	0.48	0.07	0.67	0.66	0.43	2.24	0.18	0.36	0.11	0.51	2.54	0.37	0.35
RABBIT MANURE	1.96	0.72	2.33	2.24	1.45	0.65	0.49	0.07	0.68	0.71	0.44	2.32	0.16	0.36	0.11	0.58	2.51	0.40	0.50
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON TRASH	1.24	0.52	1.39	1.33	0.70	0.30	0.36	0.03	0.58	0.46	0.40	1.48	0.14	0.26	0.05	0.16	1.79	0.18	0.11
FRUIT AND VEG	2.00	0.65	3.18	3.04	2.03	0.80	0.42	0.05	0.68	0.64	0.51	2.92	0.19	0.40	0.12	0.61	3.45	0.40	0.43
POULTRY	3.11	1.39	3.38	3.30	2.44	1.22	0.70	0.12	0.97	0.66	0.66	2.90	0.22	0.55	0.16	0.73	3.69	0.60	0.64
ANIMAL	3.10	1.40	3.51	3.35	2.45	1.22	0.69	0.13	0.95	0.91	0.65	2.90	0.22	0.53	0.15	0.72	3.69	0.69	0.58
MILK SOLIDS	1.60	0.44	1.70	1.66	1.79	0.97	0.45	0.05	0.73	0.63	0.57	1.92	0.22	0.47	0.11	0.42	2.27	0.11	0.19
SPIRITS	2.36	0.79	2.57	2.45	1.77	0.85	0.37	0.08	0.58	0.67	0.45	2.34	0.22	0.40	0.14	0.53	2.89	0.37	0.37
VEGET OILS	1.50	0.50	2.41	2.32	1.51	0.55	0.26	0.02	0.36	0.55	0.29	1.46	0.14	0.28	0.07	0.62	2.42	0.18	0.10
TALLOW	2.50	0.59	2.84	2.69	1.94	1.10	0.47	0.07	0.55	0.73	0.41	2.31	0.19	0.35	0.11	0.70	3.08	0.41	0.46
TEXTILES.	0.32	0.32	0.62	0.80	0.15	0.05	0.13	0.02	0.39	0.33	0.35	1.30	0.12	0.11	0.04	0.05	1.27	0.11	0.07
WOOD PRODUCTS	0.71	0.34	0.84	0.81	0.16	0.02	0.18	0.0	0.39	0.23	0.33	0.86	0.12	0.15	0.04	0.06	1.39	0.09	0.08
CHEMICALS	1.18	0.56	1.10	1.06	0.64	0.20	0.58	0.04	0.85	0.92	0.49	1.28	0.29	0.52	0.21	0.35	1.05	0.45	0.30
PETROLEUM	1.08	0.91	1.05	1.03	0.65	0.17	0.52	0.02	0.72	0.76	0.44	1.51	0.26	0.46	0.18	0.34	1.19	0.44	0.27
PLASTICS	0.42	0.28	0.24	0.24	0.15	0.05	0.12	0.02	0.51	0.43	0.54	1.61	0.21	0.19	0.07	0.09	1.07	0.11	0.10
MASONARY	0.66	0.39	1.03	1.00	0.24	0.05	0.23	0.03	0.37	0.19	0.04	0.20	0.09	0.03	0.04	0.07	1.07	0.17	0.17
METALS	0.95	0.42	1.06	1.03	0.37	0.11	0.27	0.05	0.27	0.35	0.09	0.48	0.13	0.08	0.05	0.12	1.07	0.24	0.21
SEEDS	1.08	0.43	2.24	2.17	1.24	0.28	0.20	0.02	0.54	0.59	0.19	1.44	0.10	0.24	0.07	0.35	2.47	0.17	0.20
TIRES	1.05	0.43	1.05	1.02	0.74	0.05	0.12	0.01	0.54	0.12	0.70	1.63	0.17	0.15	0.08	0.09	1.51	0.17	0.21

Table IV-9 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION NOT CONSIDERED POSSIBLE

Sub Region Interface

	UNMAN	SPRD	PILED ON GRD	PILE ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
GARBAGE	3.45	1.59	3.05	3.40	2.60	1.43	0.69	0.06	0.94	0.33	0.45	2.66	0.16	0.33	0.20	1.03	3.97	0.88	1.18
RES RUBBISH	2.00	1.10	2.94	2.25	1.30	0.69	0.45	0.04	0.67	0.60	0.35	2.07	0.14	0.27	0.16	0.71	3.02	0.60	0.81
MIXED GARBAGE	3.35	1.50	3.48	3.27	2.51	1.23	0.65	0.05	0.78	0.74	0.45	2.46	0.17	0.30	0.16	0.95	3.71	0.73	1.18
STREET REFUSE	1.71	0.89	1.68	1.70	1.29	0.76	0.46	0.03	0.58	0.48	0.35	1.56	0.07	0.27	0.14	0.50	2.19	0.47	0.54
DEAD ANIMALS	3.65	1.54	3.67	3.64	2.93	1.51	0.77	0.07	1.13	0.99	0.55	3.05	0.41	0.51	0.32	1.10	4.05	0.81	1.31
ABANDON VEHIC	1.06	0.70	0.65	0.56	0.31	0.16	0.16	0.01	0.31	0.18	0.52	1.65	0.15	0.19	0.15	0.21	1.50	0.41	0.37
DEMOLITION	1.34	0.87	1.39	1.29	0.51	0.16	0.36	0.03	0.47	0.30	0.31	1.15	0.09	0.12	0.14	0.20	1.74	0.38	0.31
CONSTRUCTION	1.20	0.82	0.85	0.77	0.47	0.15	0.34	0.03	0.43	0.29	0.33	1.21	0.07	0.12	0.14	0.70	1.70	0.38	0.32
SPECIAL	2.98	1.52	3.15	2.95	2.21	1.32	0.44	0.05	0.86	0.60	0.57	2.49	0.31	0.37	0.21	1.05	3.23	0.74	0.81
SEWAGE TR SLDG	2.50	0.98	2.62	2.70	1.63	0.79	0.51	0.04	0.68	0.53	0.55	2.15	0.15	0.27	0.13	0.54	3.04	0.44	0.81
WATER TR SLDG	0.82	0.57	0.67	0.64	0.37	0.16	0.31	0.03	0.46	0.35	0.45	1.23	0.23	0.25	0.08	0.15	1.12	0.20	0.23
ASHES	0.81	0.66	0.72	0.68	0.35	0.36	0.49	0.01	0.47	0.42	0.29	0.72	0.07	0.12	0.10	0.11	0.70	0.23	0.22
HUMAN FECES	3.29	1.77	3.51	3.32	2.50	1.17	0.94	0.11	1.00	1.07	0.66	2.65	0.31	0.45	0.29	0.91	3.57	0.91	1.21
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARLEY	1.07	0.84	1.10	1.05	0.67	0.07	0.17	0.00	0.57	0.53	0.41	1.14	0.10	0.11	0.10	0.12	1.31	0.21	0.19
BEANS DRY	1.06	0.86	1.13	1.09	0.65	0.03	0.21	0.00	0.52	0.57	0.44	1.29	0.10	0.14	0.10	0.12	1.47	0.20	0.14
CORN	1.35	0.86	1.83	1.75	0.65	0.08	0.21	0.00	0.52	0.57	0.44	1.55	0.10	0.14	0.10	0.12	2.17	0.20	0.14
COTTON LINT	0.99	0.75	1.67	1.03	0.62	0.05	0.19	0.00	0.51	0.46	0.41	1.27	0.09	0.14	0.08	0.12	1.32	0.17	0.13
COTTON SEED	1.03	0.83	1.11	1.07	0.65	0.09	0.21	0.00	0.50	0.55	0.44	1.29	0.10	0.14	0.09	0.12	1.45	0.18	0.14
HAY	1.06	0.86	1.13	1.09	0.65	0.03	0.21	0.00	0.52	0.57	0.44	1.29	0.10	0.14	0.10	0.12	1.47	0.20	0.14
OATS	1.14	0.94	1.19	1.14	0.73	0.03	0.21	0.00	0.57	0.62	0.44	1.55	0.12	0.15	0.11	0.12	1.52	0.20	0.19
ALFALFA	1.14	0.86	1.89	2.13	1.25	0.51	0.21	0.00	0.57	0.62	0.44	1.46	0.11	0.15	0.11	0.12	2.22	0.20	0.19
RICE	1.07	0.76	1.10	1.05	0.67	0.08	0.17	0.00	0.57	0.53	0.41	1.14	0.09	0.11	0.10	0.12	1.31	0.19	0.19
SAFFLOWER	1.06	0.86	1.13	1.09	0.65	0.08	0.21	0.00	0.52	0.57	0.44	1.29	0.10	0.14	0.10	0.12	1.47	0.20	0.14
SORGHUM	1.06	0.86	1.13	1.09	0.65	0.03	0.21	0.00	0.52	0.57	0.44	1.29	0.10	0.14	0.10	0.12	1.47	0.20	0.14
SUGAR BEETS	1.74	0.80	2.24	2.13	0.73	0.09	0.21	0.00	0.62	0.67	0.44	1.97	0.12	0.17	0.11	0.12	2.57	0.25	0.52
WHEAT	1.07	0.76	1.10	1.05	0.67	0.08	0.17	0.00	0.57	0.53	0.41	1.14	0.10	0.11	0.10	0.12	1.31	0.21	0.19
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEANS	1.47	1.04	1.53	1.50	1.12	0.16	0.58	0.04	0.81	0.86	0.41	1.38	0.05	0.32	0.15	0.18	1.89	0.37	0.29
CABBAGE	2.03	1.09	3.12	3.03	2.04	0.80	0.54	0.04	0.81	0.34	0.44	2.40	0.07	0.37	0.16	0.38	3.49	0.51	0.29
CHINESE VEGS	1.47	1.04	1.53	1.50	1.12	0.16	0.58	0.04	0.81	0.86	0.41	1.38	0.05	0.32	0.15	0.18	1.89	0.37	0.29
SWEET CORN	1.47	1.04	1.53	1.50	1.12	0.16	0.56	0.04	0.81	0.86	0.41	1.38	0.05	0.32	0.15	0.13	1.89	0.37	0.29
CUCUMBERS	1.47	1.04	1.53	1.50	1.12	0.16	0.53	0.04	0.81	0.86	0.41	1.38	0.05	0.32	0.15	0.18	1.89	0.37	0.29
MELONS	2.00	1.14	3.04	2.92	2.09	0.95	0.52	0.04	0.81	0.85	0.44	2.55	0.07	0.40	0.16	0.38	3.43	0.55	0.29
ONIONS	2.07	1.04	3.20	3.14	2.41	1.21	0.58	0.04	0.81	0.86	0.41	2.16	0.05	0.32	0.15	0.67	3.64	0.46	0.93
PEPPERS	1.47	1.04	1.53	1.50	1.12	0.16	0.53	0.04	0.81	0.85	0.41	1.38	0.05	0.32	0.15	0.13	1.89	0.37	0.29
RADISHES	1.47	1.04	1.53	1.50	1.12	0.16	0.58	0.04	0.81	0.86	0.41	1.38	0.05	0.32	0.15	0.13	1.89	0.37	0.29
ROMAINE	1.47	1.04	1.53	1.50	1.12	0.16	0.58	0.04	0.81	0.86	0.41	1.53	0.05	0.32	0.15	0.13	1.89	0.37	0.29
SQUASH	1.47	1.01	1.51	1.48	1.10	0.15	0.54	0.04	0.80	0.85	0.42	1.41	0.06	0.30	0.15	0.19	1.89	0.35	0.29
SWEET POTATOES	1.47	1.04	1.53	1.50	1.12	0.16	0.58	0.04	0.81	0.86	0.41	1.38	0.05	0.32	0.15	0.18	1.89	0.37	0.29
TOMATOES	2.91	1.15	3.17	3.06	2.26	1.08	0.54	0.04	0.83	0.84	0.44	2.64	0.08	0.40	0.15	0.59	3.57	0.52	0.34
TURNIPS	1.47	1.04	1.53	1.50	1.12	0.16	0.58	0.04	0.81	0.86	0.41	1.38	0.05	-0.32	0.15	0.18	1.89	0.37	0.29
VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table IV-9 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION NOT CONSIDERED POSSIBLE

SUB REGION INTERFACE

	UNMAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALMONDS	0.95	0.68	1.00	0.96	0.70	0.05	0.13	0.00	0.51	0.49	0.34	1.02	0.03	0.15	0.08	0.13	1.07	0.22	0.20
APRICOTS	1.54	0.78	2.56	2.42	1.53	0.73	0.37	0.01	0.62	0.55	0.36	2.07	0.03	0.15	0.09	0.31	2.57	0.29	0.16
BUSHBERRIES	1.01	0.69	1.11	1.07	0.64	0.09	0.32	0.01	0.58	0.52	0.36	1.13	0.03	0.15	0.11	0.15	1.14	0.27	0.16
FIGS	1.73	0.90	2.32	2.21	1.19	0.41	0.34	0.01	0.62	0.57	0.36	1.74	0.05	0.18	0.10	0.23	2.34	0.31	0.30
GRAPEFRUIT	1.62	0.74	2.15	2.04	0.87	0.30	0.27	0.01	0.57	0.50	0.36	1.68	0.03	0.14	0.11	0.15	2.21	0.24	0.17
GRAPES	1.70	0.76	2.38	2.25	1.57	0.79	0.37	0.01	0.57	0.51	0.36	2.04	0.03	0.15	0.09	0.36	2.40	0.27	0.16
LEMONS	1.60	0.72	2.15	2.04	0.87	0.30	0.27	0.01	0.56	0.50	0.36	1.68	0.03	0.14	0.11	0.15	2.21	0.24	0.17
NECTARINES	1.91	0.89	2.70	2.56	1.59	0.75	0.37	0.01	0.61	0.52	0.39	1.95	0.04	0.23	0.09	0.17	2.70	0.30	0.16
OLIVES	1.01	0.69	1.11	1.07	0.64	0.09	0.32	0.01	0.58	0.52	0.36	1.13	0.03	0.15	0.11	0.15	1.14	0.27	0.16
ORANGES	1.01	0.81	2.20	2.10	1.13	0.47	0.27	0.01	0.59	0.55	0.36	1.84	0.06	0.16	0.10	0.21	2.26	0.27	0.22
PEACHES	2.19	0.90	3.04	2.88	1.36	0.90	0.39	0.01	0.64	0.58	0.39	2.39	0.06	0.24	0.10	0.44	3.06	0.43	0.22
PERSIMMONS	1.01	0.69	1.11	1.07	0.64	0.09	0.32	0.01	0.58	0.52	0.36	1.13	0.03	0.15	0.11	0.15	1.14	0.27	0.16
PLUMS	1.37	0.80	2.73	2.59	1.53	0.69	0.37	0.01	0.62	0.53	0.39	2.18	0.04	0.23	0.09	0.32	2.73	0.30	0.16
POMEGRANATES	1.01	0.69	1.11	1.07	0.64	0.09	0.32	0.01	0.58	0.52	0.36	1.13	0.03	0.15	0.11	0.15	1.14	0.27	0.16
STRAWBERRIES	1.01	0.69	1.11	1.07	0.63	0.11	0.39	0.01	0.73	0.73	0.36	1.14	0.03	0.26	0.10	0.15	1.26	0.25	0.19
WALNUTS	1.27	0.76	1.71	1.53	0.71	0.08	0.14	0.00	0.54	0.51	0.36	1.05	0.03	0.15	0.10	0.13	1.79	0.28	0.20
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CATTLE MANURE	3.25	1.25	3.52	3.33	2.04	0.84	0.52	0.06	0.91	0.88	0.45	2.73	0.19	0.32	0.18	0.98	3.80	0.53	0.87
SHEEP MANURE	1.65	0.94	2.23	2.10	1.11	0.48	0.50	0.06	0.74	0.72	0.39	1.66	0.16	0.27	0.17	0.58	2.47	0.35	0.44
HOG MANURE	2.67	1.01	3.05	2.86	1.64	0.85	0.48	0.07	0.75	0.73	0.39	2.55	0.16	0.27	0.17	0.92	3.24	0.50	0.59
HORSE MANURE	2.37	0.94	2.97	2.79	1.66	0.83	0.49	0.06	0.74	0.72	0.39	2.26	0.16	0.28	0.17	0.74	3.17	0.46	0.51
CHICK MANURE	2.90	0.95	3.05	2.86	1.81	0.90	0.52	0.06	0.75	0.74	0.39	2.65	0.17	0.28	0.16	0.87	3.29	0.49	0.86
TURKEY MANURE	1.73	0.93	2.31	2.17	1.34	0.69	0.49	0.06	0.75	0.72	0.39	1.95	0.16	0.28	0.16	0.59	2.48	0.37	0.44
PIGEON MANURE	2.20	0.95	2.40	2.25	1.59	0.73	0.48	0.06	0.74	0.71	0.39	2.21	0.16	0.28	0.16	0.52	2.73	0.45	0.39
RABBIT MANURE	2.28	0.94	2.52	2.37	1.51	0.69	0.49	0.06	0.74	0.74	0.39	2.29	0.16	0.28	0.16	0.58	2.70	0.48	0.54
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON TRASH	1.41	0.67	1.49	1.39	0.75	0.32	0.31	0.02	0.56	0.43	0.38	1.46	0.12	0.22	0.11	0.21	1.91	0.28	0.18
FRUIT AND VEG	2.33	1.09	3.32	3.14	2.05	0.82	0.38	0.03	0.68	0.61	0.46	2.88	0.15	0.30	0.14	0.65	3.56	0.46	0.50
POULTRY	3.34	1.63	3.55	3.40	2.47	1.22	0.63	0.10	0.98	0.89	0.62	2.90	0.20	0.44	0.22	0.77	3.83	0.69	0.68
ANIMAL	3.32	1.66	3.68	3.46	2.49	1.22	0.62	0.11	0.97	0.92	0.59	2.90	0.21	0.42	0.21	0.75	3.82	0.76	0.63
MILK SOLIDS	1.75	0.61	1.80	1.75	1.81	0.98	0.39	0.03	0.66	0.65	0.54	2.05	0.20	0.36	0.14	0.43	2.34	0.20	0.26
SPIRITS	2.50	0.95	2.65	2.48	1.74	0.86	0.32	0.06	0.59	0.67	0.39	2.32	0.19	0.31	0.18	0.57	2.95	0.44	0.43
VEGET OILS	1.76	0.73	2.54	2.41	1.53	0.59	0.25	0.01	0.38	0.55	0.26	1.54	0.13	0.21	0.11	0.71	2.66	0.33	0.21
TALLOW	2.77	1.20	2.98	2.80	2.00	1.20	0.41	0.06	0.55	0.74	0.37	2.33	0.13	0.27	0.13	0.74	3.20	0.43	0.53
TEXTILES	1.00	0.50	0.90	0.86	0.19	0.08	0.12	0.01	0.45	0.35	0.34	1.32	0.11	0.09	0.09	0.14	1.43	0.21	0.16
WOOD PRODUCTS	0.98	0.59	1.01	0.95	0.26	0.07	0.22	0.0	0.52	0.31	0.34	1.11	0.12	0.16	0.10	0.16	1.72	0.21	0.18
CHEMICALS	1.58	1.30	1.41	1.27	0.82	0.23	0.60	0.03	0.96	1.01	0.54	1.45	0.36	0.49	0.34	0.45	1.35	0.65	0.41
PETROLEUM	1.35	1.13	1.26	1.18	0.74	0.17	0.54	0.01	0.86	0.87	0.44	1.61	0.30	0.44	0.26	0.42	1.43	0.59	0.42
PLASTICS	0.78	0.55	0.42	0.42	0.25	0.07	0.15	0.01	0.67	0.48	0.54	1.72	0.21	0.23	0.13	0.22	1.41	0.26	0.20
MASONARY	1.07	0.63	1.16	1.08	0.28	0.09	0.23	0.02	0.47	0.26	0.06	0.56	0.08	0.04	0.10	0.17	1.22	0.29	0.29
METALS	1.30	0.77	1.34	1.26	0.60	0.20	0.37	0.05	0.29	0.45	0.15	0.63	0.14	0.12	0.12	0.26	1.31	0.42	0.37
SEEDS	2.09	0.84	2.53	2.43	1.41	0.32	0.31	0.02	0.67	0.72	0.24	1.56	0.15	0.25	0.18	0.49	2.77	0.38	0.35
TIRES	1.43	0.79	1.21	1.16	0.84	0.08	0.11	0.01	0.54	0.16	0.66	1.69	0.18	0.17	0.14	0.20	1.74	0.29	0.29

Table IV-9 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION NOT CONSIDERED POSSIBLE

SUB REGION AGRICULTURAL

	UNMAN	SPRD	PILED ON GRD	PILED ON SLABS	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGON	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
GARBAGE	4.62	1.94	4.57	4.21	3.01	1.42	0.55	0.04	1.53	1.11	0.21	2.20	0.19	0.31	0.57	1.28	4.62	1.36	1.31
RES RUBBISH	2.53	1.43	2.67	2.63	1.71	0.76	0.33	0.03	0.99	0.90	0.15	1.51	0.03	0.11	0.45	0.93	3.11	1.00	0.92
MIXED GARBAGE	3.40	1.84	3.51	3.65	2.72	1.28	0.49	0.04	1.00	0.89	0.22	1.85	0.09	0.14	0.45	1.11	3.62	1.16	1.24
STREET REFUSE	2.81	1.54	2.69	2.32	1.41	0.80	0.34	0.02	1.06	0.59	0.17	1.06	0.14	0.39	0.48	0.63	2.50	0.97	0.61
DEAD ANIMALS	4.14	2.11	4.21	3.88	2.95	1.40	0.49	0.04	1.36	0.82	0.26	2.56	0.47	0.47	0.70	1.35	4.32	1.13	1.28
ABANDON VEHIC	1.06	0.69	0.69	0.60	0.37	0.22	0.08	0.01	0.28	0.23	0.24	1.01	0.08	0.11	0.17	0.24	1.24	0.42	0.37
DEMOLITION	1.61	1.11	1.71	1.48	0.60	0.23	0.24	0.02	0.66	0.57	0.15	0.82	0.05	0.06	0.33	0.31	1.77	0.64	0.36
CONSTRUCTION	1.53	1.03	1.13	0.93	0.54	0.21	0.23	0.02	0.60	0.56	0.17	0.81	0.04	0.06	0.33	0.35	1.68	0.64	0.39
SPECIAL	3.70	1.91	3.75	3.42	2.40	1.38	0.38	0.04	1.44	1.19	0.36	2.24	0.70	0.66	0.69	1.42	3.79	1.25	1.00
SEWAGE TR SLDG	3.23	1.33	3.21	3.02	1.87	0.82	0.42	0.02	0.92	0.75	0.24	1.67	0.03	0.12	0.41	0.76	3.05	0.81	0.91
WATER TR SLDG	0.77	0.40	0.59	0.54	0.34	0.17	0.17	0.01	0.36	0.24	0.23	0.76	0.09	0.10	0.11	0.19	0.82	0.26	0.24
ASHES	0.69	0.48	0.58	0.51	0.22	0.07	0.23	0.00	0.30	0.24	0.13	0.50	0.03	0.05	0.11	0.14	0.46	0.26	0.21
HUMAN FECES	3.39	2.02	3.72	3.61	2.60	1.21	0.75	0.09	1.33	1.30	0.33	2.30	0.63	0.57	0.74	0.90	3.97	1.27	1.50
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARLEY	1.63	1.23	1.65	1.47	0.78	0.11	0.15	0.00	0.88	0.81	0.21	0.75	0.06	0.07	0.38	0.20	1.54	0.59	0.22
BEANS DRY	1.58	1.20	1.64	1.45	0.72	0.12	0.16	0.00	0.84	0.80	0.22	0.86	0.05	0.07	0.38	0.20	1.57	0.58	0.17
CORN	1.86	1.20	2.34	2.11	0.72	0.12	0.16	0.00	0.84	0.80	0.22	1.12	0.05	0.07	0.38	0.20	2.27	0.58	0.17
COTTON LINT	1.37	0.95	1.40	1.28	0.71	0.13	0.14	0.00	0.62	0.55	0.21	0.85	0.05	0.08	0.23	0.17	1.36	0.38	0.16
COTTON SEED	1.39	0.99	1.41	1.29	0.72	0.14	0.15	0.00	0.62	0.58	0.22	0.86	0.05	0.07	0.23	0.17	1.42	0.38	0.16
HAY	1.58	1.20	1.64	1.45	0.72	0.12	0.16	0.00	0.84	0.80	0.22	0.86	0.05	0.07	0.38	0.20	1.57	0.58	0.17
OATS	1.60	1.28	1.59	1.50	0.80	0.12	0.16	0.00	0.88	0.84	0.22	0.92	0.07	0.08	0.38	0.20	1.63	0.58	0.23
ALFALFA	1.60	1.20	2.39	2.49	1.32	0.54	0.16	0.00	0.88	0.84	0.22	1.06	0.07	0.08	0.38	0.20	2.33	0.58	0.23
RICE	1.63	1.15	1.65	1.47	0.78	0.12	0.15	0.00	0.88	0.81	0.21	0.76	0.06	0.07	0.38	0.19	1.54	0.57	0.22
SAFFLOWER	1.58	1.20	1.64	1.45	0.72	0.12	0.16	0.00	0.84	0.80	0.22	0.86	0.05	0.07	0.38	0.20	1.57	0.58	0.17
SORGHUM	1.58	1.20	1.64	1.45	0.72	0.12	0.16	0.00	0.84	0.80	0.22	0.86	0.05	0.07	0.38	0.20	1.57	0.58	0.17
SUGAR BEETS	2.23	1.20	2.74	2.49	0.80	0.12	0.16	0.00	0.93	0.89	0.22	1.54	0.07	0.10	0.38	0.20	2.68	0.63	0.55
WHEAT	1.63	1.15	1.65	1.47	0.78	0.12	0.15	0.00	0.88	0.81	0.21	0.76	0.06	0.07	0.38	0.20	1.54	0.59	0.22
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEANS	1.92	1.35	1.90	1.72	1.08	0.20	0.38	0.03	1.01	0.96	0.22	0.99	0.04	0.17	0.42	0.28	1.93	0.75	0.31
CABBAGE	2.52	1.41	3.48	3.20	1.99	0.33	0.36	0.03	1.01	0.95	0.22	1.93	0.04	0.18	0.43	0.45	3.51	0.88	0.31
CHINESE VEGS	1.92	1.35	1.90	1.72	1.08	0.20	0.38	0.03	1.01	0.96	0.22	0.99	0.04	0.17	0.42	0.28	1.93	0.75	0.31
SWEET CORN	1.92	1.35	1.90	1.72	1.08	0.20	0.38	0.03	1.01	0.96	0.22	0.99	0.04	0.17	0.42	0.28	1.93	0.75	0.31
CUCUMBERS	1.92	1.35	1.90	1.72	1.08	0.20	0.38	0.03	1.01	0.96	0.22	0.99	0.04	0.17	0.42	0.28	1.93	0.75	0.31
MELONS	3.03	1.47	3.41	3.13	2.04	0.99	0.35	0.03	1.01	0.95	0.22	2.07	0.05	0.19	0.43	0.46	3.44	0.92	0.32
ONIONS	2.52	1.35	3.65	3.37	2.38	1.25	0.38	0.03	1.01	0.95	0.22	1.76	0.04	0.17	0.42	0.77	3.68	0.84	0.96
PEPPERS	1.92	1.35	1.90	1.72	1.08	0.20	0.38	0.03	1.01	0.96	0.22	0.99	0.04	0.17	0.42	0.28	1.93	0.75	0.31
RADISHES	1.92	1.35	1.90	1.72	1.08	0.20	0.38	0.03	1.01	0.96	0.22	0.99	0.04	0.17	0.42	0.28	1.93	0.75	0.31
ROMAINE	1.92	1.35	1.90	1.72	1.08	0.20	0.38	0.03	1.01	0.96	0.22	0.99	0.04	0.17	0.42	0.28	1.93	0.75	0.31
SQUASH	1.92	1.34	1.90	1.71	1.08	0.20	0.36	0.03	1.01	0.96	0.22	1.00	0.04	0.16	0.42	0.29	1.93	0.74	0.31
SWEET POTATOES	1.92	1.35	1.90	1.72	1.08	0.20	0.38	0.03	1.01	0.96	0.22	0.99	0.04	0.17	0.42	0.28	1.93	0.75	0.31
TOMATOES	3.34	1.40	3.55	3.32	2.35	1.21	0.42	0.03	0.97	0.91	0.22	2.26	0.05	0.21	0.23	0.66	3.58	0.71	0.35
TURNIPS	1.92	1.35	1.90	1.72	1.08	0.20	0.38	0.03	1.01	0.96	0.22	0.99	0.04	0.17	0.42	0.28	1.93	0.75	0.31
VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table IV-9 (Continued)

SUMMARIZED BAD EFFECTS SCORES, WATER POLLUTION NOT CONSIDERED POSSIBLE

Sub Region Agricultural

	URBAN	SPRD	PILED ON GRD	PILED ON SLABS,	CONT OPEN	CONT CLOSE	TRANS OPEN	TRANS CLOSE	GRIND	SPRAY IRRIG	INCIN	OPEN BURN	COMST	LAGUN	LAND FILL	BURY	OPEN DUMP	PLOW INTO GRD	PIT DISP
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALMONDS	1.45	1.04	1.46	1.39	1.08	0.18	0.19	0.00	0.61	0.56	0.17	0.75	0.03	0.08	0.20	0.20	1.33	0.43	0.22
APRICOTS	2.50	1.04	2.87	2.70	1.84	0.32	0.30	0.01	0.65	0.55	0.18	1.72	0.02	0.07	0.20	0.37	2.70	0.44	0.17
BUSHBERRIES	1.50	1.05	1.55	1.46	1.06	0.14	0.34	0.01	0.78	0.67	0.18	0.79	0.02	0.07	0.32	0.23	1.40	0.55	0.18
FIGS	2.15	1.20	2.04	2.49	1.50	0.50	0.31	0.01	0.74	0.65	0.19	1.43	0.04	0.11	0.21	0.31	2.52	0.46	0.30
GRAPEFRUIT	2.10	1.11	2.59	2.44	1.31	0.35	0.32	0.01	0.77	0.67	0.18	1.32	0.02	0.06	0.32	0.23	2.46	0.55	0.19
GRAPES	2.07	1.07	2.09	2.54	1.89	0.38	0.34	0.01	0.69	0.59	0.18	1.73	0.02	0.09	0.20	0.44	2.57	0.43	0.17
LEMONS	2.10	1.10	2.59	2.44	1.31	0.35	0.32	0.01	0.76	0.67	0.18	1.32	0.02	0.06	0.32	0.23	2.46	0.55	0.19
NECTARINES	2.33	1.17	3.06	2.82	1.89	0.38	0.33	0.01	0.64	0.53	0.19	1.60	0.02	0.10	0.16	0.22	2.88	0.42	0.16
OLIVES	1.50	1.05	1.55	1.46	1.06	0.14	0.34	0.01	0.78	0.67	0.18	0.79	0.02	0.07	0.32	0.23	1.40	0.55	0.18
ORANGES	2.10	1.14	2.64	2.50	1.54	0.59	0.30	0.01	0.76	0.67	0.18	1.56	0.04	0.11	0.21	0.28	2.51	0.44	0.22
PEACHES	2.60	1.19	3.39	3.19	2.17	1.03	0.36	0.01	0.68	0.59	0.19	2.02	0.04	0.12	0.17	0.50	3.22	0.53	0.22
PERSIMMONS	1.50	1.05	1.55	1.46	1.06	0.14	0.34	0.01	0.78	0.67	0.18	0.79	0.02	0.07	0.32	0.23	1.40	0.55	0.18
PLUMS	2.22	1.00	3.02	2.84	1.78	0.79	0.31	0.01	0.65	0.54	0.19	1.80	0.02	0.10	0.16	0.38	2.86	0.42	0.16
POMEGRANATES	1.50	1.05	1.55	1.46	1.06	0.14	0.34	0.01	0.78	0.67	0.18	0.79	0.02	0.07	0.32	0.23	1.40	0.55	0.18
STRAWBERRIES	1.50	1.00	1.55	1.40	1.03	0.23	0.35	0.01	0.80	0.72	0.18	0.88	0.02	0.13	0.21	0.23	1.45	0.40	0.18
WALNUTS	1.37	1.21	2.26	2.15	1.20	0.14	0.27	0.00	0.80	0.73	0.20	0.73	0.03	0.08	0.32	0.23	2.15	0.63	0.23
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CATTLE MANURE	3.97	1.63	4.02	3.52	2.11	0.88	0.42	0.05	1.35	1.22	0.25	2.29	0.15	0.22	0.45	1.03	4.04	0.96	0.94
SHEEP MANURE	2.42	1.33	2.76	2.30	1.17	0.52	0.42	0.05	1.19	1.06	0.19	1.22	0.13	0.13	0.44	0.64	2.75	0.80	0.52
HOG MANURE	3.51	1.44	3.55	3.04	1.70	0.86	0.39	0.04	1.19	1.07	0.20	2.10	0.14	0.19	0.44	0.97	3.49	0.93	0.65
HORSE MANURE	3.14	1.38	3.49	2.99	1.73	0.88	0.41	0.05	1.19	1.06	0.19	1.82	0.13	0.18	0.44	0.80	3.45	0.90	0.59
CHICK MANURE	3.70	1.39	3.54	3.04	1.87	0.94	0.42	0.05	1.20	1.08	0.20	2.21	0.14	0.18	0.44	0.92	3.53	0.92	0.93
TURKEY MANURE	2.47	1.37	2.81	2.35	1.41	0.73	0.39	0.05	1.20	1.06	0.19	1.51	0.13	0.18	0.44	0.64	2.73	0.80	0.52
PIGEON MANURE	2.57	1.39	2.91	2.44	1.66	0.73	0.39	0.05	1.19	1.06	0.15	1.77	0.13	0.13	0.44	0.59	3.00	0.89	0.47
RABBIT MANURE	3.05	1.38	3.04	2.57	1.58	0.73	0.41	0.05	1.19	1.08	0.23	1.54	0.14	0.18	0.44	0.64	2.99	0.92	0.61
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON TRASH	1.71	0.77	1.65	1.59	0.76	0.35	0.24	0.00	0.58	0.46	0.18	0.90	0.05	0.09	0.25	0.24	1.81	0.48	0.18
FRUIT AND VEG	3.06	1.35	3.58	3.37	2.23	0.91	0.30	0.02	0.70	0.57	0.22	2.29	0.06	0.14	0.19	0.69	3.45	0.58	0.48
POULTRY	3.75	1.37	4.01	3.72	2.60	1.24	0.44	0.08	1.13	1.03	0.32	2.48	0.37	0.38	0.51	0.95	4.19	0.92	0.71
ANIMAL	3.72	1.91	4.10	3.77	2.68	1.24	0.43	0.09	1.11	1.05	0.29	2.40	0.32	0.37	0.50	0.92	4.17	0.97	0.65
MILK SOLIDS	1.70	0.59	1.73	1.69	1.76	1.01	0.24	0.02	0.41	0.43	0.26	1.56	0.09	0.15	0.12	0.51	1.99	0.27	0.25
SPIRITS	2.73	1.13	2.85	2.46	1.72	0.88	0.23	0.04	0.73	0.75	0.22	1.34	0.12	0.17	0.31	0.61	2.96	0.63	0.46
VEGET OILS	1.65	0.63	2.42	2.25	1.45	0.63	0.17	0.00	0.31	0.37	0.15	1.26	0.07	0.10	0.15	0.77	2.70	0.49	0.25
TALLOW	2.03	1.07	2.86	2.67	1.92	1.25	0.29	0.05	0.46	0.51	0.18	1.74	0.07	0.13	0.13	0.73	2.92	0.42	0.54
TEXTILES	0.94	0.44	0.66	0.61	0.19	0.11	0.06	0.00	0.37	0.25	0.15	0.82	0.06	0.04	0.12	0.19	1.29	0.24	0.18
WOOD PRODUCTS	1.14	0.74	1.21	1.14	0.26	0.11	0.15	0.0	0.73	0.46	0.20	0.50	0.07	0.08	0.27	0.27	1.84	0.46	0.21
CHEMICALS	2.50	1.87	2.05	1.61	1.01	0.25	0.45	0.02	1.69	1.59	0.62	1.47	0.71	0.77	1.03	0.97	2.05	1.38	0.58
PETROLEUM	1.69	1.57	1.76	1.43	0.78	0.13	0.42	0.00	1.44	1.41	0.34	1.28	0.47	0.65	0.51	0.64	1.33	1.11	0.58
PLASTICS	0.95	0.62	0.70	0.69	0.39	0.13	0.13	0.00	0.77	0.43	0.30	1.22	0.09	0.12	0.17	0.37	1.31	0.42	0.26
MASONARY	1.26	0.77	1.39	1.14	0.23	0.15	0.18	0.01	0.69	0.49	0.04	0.45	0.04	0.02	0.25	0.34	1.39	0.53	0.36
METALS	1.52	0.96	1.56	1.44	0.77	0.35	0.41	0.07	0.28	0.51	0.15	0.59	0.11	0.14	0.18	0.43	1.49	0.60	0.46
SEEDS	2.93	1.58	3.50	3.25	1.87	0.40	0.42	0.03	1.23	1.29	0.32	1.51	0.42	0.31	0.52	0.74	3.45	0.91	0.47
TIRES	1.57	0.91	1.48	1.41	1.06	0.13	0.06	0.01	0.33	0.17	0.34	1.07	0.03	0.08	0.13	0.23	1.55	0.34	0.30

Table IV-10

PERFORMANCE SCORES (HYPOTHETICAL EXAMPLE)

Proposed Systems*	Cow Manure	Grapes	Cotton Trash	Dead Animals	Pigeon Manure	Seeds	Walnuts	Sub-total
			Transient Elements					
A	2	1	0.5	2	1	0.5	0.5	7.5
B	0.5	0.4	0.4	1	0.5	0.3	0.3	3.3
C	0.8	1	0.3	0.4	0.7	0.1	0.2	3.5
D	3	2	1	3	2	1	1	13
			Final Disposal Elements					
A	100	50	20	100	50	30	25	375
B	150	100	30	200	75	35	40	630
C	75	40	10	80	35	20	10	270
D	40	10	5	50	10	15	5	135

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*One of these systems will be the "existing system" used as a comparison reference in the actual scoring.

Table IV-11

PERFORMANCE SCORE INPUT DATA

Card No.	Variable	Description	Comments	Col. Location Col. -- Thru.
1	NID	Type of subregion	Put a 1 in appropriate Col.	
			Municipal	1
			Agricultural	2
			Industrial	3
			Interface	4
2	NSREG	Name of region	Write name of region being scored e.g. Fresno	1 -- 12
3	NSYST	System title	Write title of system being scored e.g. Fresno Storage System	1 -- 36
4	NPOL	Water pollution possibility	0 indicates Water Pollution not possible 1 indicates Water Pollution is possible	1
	LST	First waste used Identification No.	First waste is lowest numerical waste identification number being evaluated. Right hand justify	2 -- 4
	LEND	Last waste used Identification No.	Last waste highest numerical waste identification number being evaluated. Right hand justify	5 -- 7

Table IV-11

PERFORMANCE SCORE INPUT DATA (Continued)

Card No.	Description		Comments	Col. Location Col. -- Thru.
Waste Ld.	Waste load in tons for amount of waste in particular condition.		Wastes are entered in numerical order with two cards used for each waste. Tonage entered as fixed point real number. Two cards must be inserted for each number between "LST" & "LEND". If intermediate numbered waste is not present enter two blank cards.	
	Waste Conditions			
1st Card	Unmanaged	1	If a particular waste has quantities in several condition. Enter the several quantities in the appropriate condition locations. If all locations are on one card leave other card blank.	1 -- 8
	Spread on Ground	2		9 -- 16
	Piled on Ground	3		17 -- 24
	Piled on Slab	4		25 -- 32
	Open Container	5		33 -- 40
	Closed Container	6		41 -- 48
	Open Transport	7		49 -- 56
	Closed Transport	8		57 -- 64
	Grinding	9	Waste quantities in conditions 1 through 10 are entered on 1st card for particular waste. Waste quantities in Condition 11 through 19 are entered on 2nd card for particular waste.	65 -- 72
	Spray Irrigation	10		73 -- 80

Table IV-11

PERFORMANCE SCORE INPUT DATA (Continued)

Card No.	Description		Comments	Col. Location Col. -- Thru.
2nd Card	Incinerate	11		1 -- 8
	Open Burning	12		9 -- 16
	Compost	13		17 -- 24
	Lagoon	14		25 -- 32
	Landfill	15		33 -- 40
	Buried	16		41 -- 48
	Open Dump	17		49 -- 56
	Plowed in Ground	18		57 -- 64
	Pit Disposal	19		65 -- 72

V. ANCILLARY EFFECTS SCORING PROCEDURE

A. INTRODUCTION

Section IV derives a method for determining the degree to which various alternative solid waste management systems solve the environmental effects of solid wastes. In this section, a means for comparing the environmental effects of the physical objects that make up a waste management system is developed. Two totally different systems may have exactly the same effect on maintaining a desirable environment when consideration is given only to solid wastes. They may differ dramatically, however, in the manner that the physical objects constituting the management system interact with their environment. For example, a system that employs trucks to collect solid wastes from households creates noise, traffic interference, exhaust fumes, and is a safety hazard, compared to an alternate method of collection, say, underground tubes, that does not interact with the environment in any of these ways. If both systems are equally effective, as reflected by their Performance Scores, and if both cost the same, the underground tube approach would appear to be more desirable because of its better "A" score. It is to be noted, however, that only four ancillary effects were mentioned in the above comparison. There may be other system effects that override the four considered and, in the final analysis, prove the truck collection system superior.

B. PROCEDURE

1. Definitions of Effects

The first step in deriving a methodology for scoring ancillary effects ("A" scores) of solid waste management systems was the identification and definition of the possible system environmental effects. Physical, social, and psychological aspects of the problem were all considered. From the original list of probable and possible effects, duplications and overlapping was eliminated (to the extent possible) resulting in the following ancillary effects:

a. Noise - Refers to the generation of sound that is noticeably loud, harsh, discordant, and/or disagreeable.

b. Traffic Interference - Refers to any equipment or component that impedes or in any way affects the normal flow of traffic.

c. Land Pollution - Refers to the operation of any equipment that affects land use, reuse, or reclamation in a detrimental manner.

d. Odor - Refers to disagreeable and/or objectional smells that are associated primarily with the operation of the system. This would include noxious and/or toxic machinery exhaust products as well as odors generated by a process that is primarily a function of that process and not of the waste itself.

e. Unsightliness - Refers to any aspects of the system that are visually ugly, distasteful, annoying, and distracting.

f. Safety Hazards - Refers to any system or system component that poses a threat to life, limb, or health of the operators and/or general public.

g. Air Pollution - Refers to anything that adds to air pollution as a function of the system and not of the waste itself. For example, increased emissions from internal combustion engines used as the power source for operating the system.

h. Water Pollution - Refers to pollution of surface or groundwater which results from operation of the system, such as thermal pollution of streams or lakes due to a system that requires excessive amounts of cooling water.

i. Legal Problems - Refers to those problems which arise from the existence of legislation which prevents the implementation of a new system or subsystem, or the need to pass new laws to force or encourage the implementation of a new system or subsystem.

j. Jurisdictional Conflicts - Refers to those effects that are incurred by the operation of a system which requires crossing boundaries such as municipal, county, etc.

k. Employment Effects - Refers to reduced employment which may be experienced as the result of the use of any system or system component.

i. Social Status - Refers to the fact that there is a certain social stigma associated with being a "garbage man." Any system which upgrades the classification of the workers (i.e., to "technician," "mechanic," etc.) is to be considered more desirable than one that does not, since it is connected to the mental well-being or pride of the workers.

Effects c to h above will be recognized as environmental effects considered in the performance scoring. Again, it must be emphasized that the ancillary effects being evaluated in this section are only those associated with the physical systems without any reference to the solid wastes. The definitions provide justification for including land pollution, odor, unsightliness, safety hazards, air and water pollution as environmental effects of systems as well as of solid wastes. All other effects of solid wastes were determined not to be noticeable effects of solid waste systems.

2. Ranking and Rating of Effects

The second step required a determination of the relative importance and subsequent weighting factors for each of the identified ancillary effects. The forced decision-making method previously used in the ranking of environmental effects for the Performance Scoring Procedure (page IV-7) was applied. A total of twenty individuals provided separate rankings in this case, whereas, for the Performance Scoring Procedure, only one compromise ranking was obtained. The one ranking represented the judgment of several environmental experts. The several, used for ancillary effects, ranged from technical to nontechnical personnel, including two secretaries and one housewife. The relative importance of ancillary effects tends to vary with the subregion, (i.e., municipal, industrial, agriculture, and interface); consequently, rankings were provided for each subregion. The rankings were then totaled for each subregion, as shown in Table V-1 through V-4. A second variation in the methodology developed for "A" scores, as compared to performance scores, is provided by the approach to weighting of the effects. Since a wider range of value judgments was used in this case, it was determined that ratios of total ranking scores (the sum of 20 rankings) to the highest score would be used as weights. These weights are also shown in Tables V-1 through V-4.

3. Application of "A" Scores

The third and final step is the application of the weights to ancillary effects for various candidate systems. This will actually be done in Section VIII of this report. The procedure will be explained in this section and a sample provided.

The derivation of "A" scores for conceptual solid waste management systems requires a comparison of "A" scores for functional candidate systems. Candidate systems have been postulated on the basis of five separate functions: storage, collection, transportation, processing, and disposal. This "building-block" approach is used for developing performance scores and is readily adaptable to "A" score determination.

Figure V-1 provides a sample of "A" score determination for the comparison of two hypothetical, albeit possible, conceptual systems. The systems discussed in the sample case will be for municipal wastes from a municipal region. System 1 consists of makeshift containers for storage, truck collection at curbside, truck transportation, grinding for bulk reduction, and ultimate disposal in a sanitary landfill. System 2 consists of built-in containers for storage, truck collection from back yards, train transportation, baling for bulk reduction, and ultimate disposal in a sanitary landfill.

V. Ancillary Effects Scoring Procedure, B (Continued)

Table V-1

"A" Scores Ranking & Weighting

Municipal Region

	Ranking Score	Weight
Safety Hazards	219	1.00
Water Pollution	196	.89
Air Pollution	172	.78
Odor	140	.64
Employment Effects	108	.49
Unsightliness	107	.49
Land Pollution	76	.35
Traffic Interference	76	.35
Noise	72	.33
Social Status	56	.26
Jurisdictional Conflicts	49	.22
Legal Problems	49	.22

V. Ancillary Effects Scoring Procedure, B (Continued)

Table V-2

"A" Scores Ranking & Weighting

Industrial Region

	Ranking Score	Weight
Safety Hazards	220	1.00
Water Pollution	190	.86
Air Pollution	162	.74
Employment Effects	135	.61
Odor	117	.53
Traffic Interference	94	.43
Unsightliness	89	.40
Jurisdictional Conflicts	74	.34
Legal Problems	72	.33
Land Pollution	62	.28
Social Status	58	.26
Noise	47	.21

V. Ancillary Effects Scoring Procedure, B (Continued)

Table V-3

"A" Scores Ranking & Weighting

Agricultural Region

	Ranking Score	Weight
Safety Hazards	220	1.00
Water Pollution	200	.91
Land Pollution	174	.79
Air Pollution	148	.67
Employment Effects	105	.48
Odor	100	.45
Legal Problems	70	.32
Traffic Interference	70	.32
Jurisdictional Conflicts	62	.28
Unsightliness	62	.28
Social Status	61	.28
Noise	48	.22

V. Ancillary Effects Scoring Procedure, B (Continued)

Table V-4

"A" Scores Ranking & Weighting

Interface Region

	Ranking Score	Weight
Safety Hazards	220	1.00
Water Pollution	196	.89
Air Pollution	172	.78
Land Pollution	143	.65
Odor	116	.53
Employment Effects	111	.51
Unsightliness	85	.39
Traffic Interference	66	.30
Social Status	56	.25
Legal Problems	53	.24
Jurisdictional Conflicts	50	.23
Noise	48	.22

V. Ancillary Effects Scoring Procedure, B (Continued)

FUNCTION	SYSTEMS COMPARISON	RANK & SCORE	NOISE	TRAFFIC INTERFERENCE	LAND POLLUTION	ODOR	UNSIGHTLINESS	SAFETY HAZARDS	AIR POLLUTION	WATER POLLUTION	LEGAL PROBLEMS	JURISDICTIONAL CONFLICTS	EMPLOYMENT EFFECT	SOCIAL STATUS	SCORE 1	SCORE 2
Storage	1. Make-shift Containers	R	2	--	0	2	2	3	2	--	0	--	0	1	7.74	
		S	.66			1.28	0.98	3.00	1.56					.26		
	2. Built-in Containers	R	1	--	1	1	1	1	1	--	1	--	1	0		4.30
		S	.33		.35	0.64	0.49	1.00	0.78		.22		.49			
Collection	1. Truck Collection at Curbside	R	--	--	--	--	1	3	--	--	--	--	1	--	3.98	
		S					.49	3.00					.49			
	2. Truck Collection - Backyard	R	--	--	--	--	0	2	--	--	--	--	0	--		2.00
		S						2.00								
Transportation	1. Truck	R	3	3	--	--	1	3	--	--	--	0	0	--	3.53	
		S	.99	1.05			.49	1.00								
	2. Train	R	1	1	--	--	0	1	--	--	--	1	1	--		2.39
		S	.33	.35				1.00				.22	.49			
Processing	1. Grinding	R	3	--	--	--	--	3	--	--	--	--	--	--	3.99	
		S	.99					3.00								
	2. Baling	R	2	--	--	--	--	2	--	--	--	--	--	--		2.66
		S	.66					2.00								
Disposal	1. Sanitary Landfill	R	--	--	--	--	--	--	--	--	--	--	--	--	--	
		S														
	2. Sanitary Landfill	R	--	--	--	--	--	--	--	--	--	--	--	--		--
		S														
TOTAL	1.	S													19.24	
SCORE	2.	S														13.35

Figure V-1. "A" Scoring

In comparing one system to another it is recognized that a range of seriousness of ancillary effects is possible. One system can be very noisy, i.e., produce a serious effect with respect to noise, while the other system may produce moderate, minor, or even no noise. To allow for this variation in degree of effect, the following scale is used:

Serious effect	3
Moderate effect	2
Minor effect	1
No effect	0

Using this scale, the analyst can compare candidate systems, by function, as to their contribution to each ancillary effect.

Figure V-1 shows a sample comparison of the two hypothetical systems. System 1, with respect to the storage function, was considered to produce moderate noise and was, therefore, ranked "2". System 2 was considered to produce minor noise and was ranked "1". This analysis was made for the candidate systems for each ancillary effect within each function. It is possible that not all ancillary effects have a relationship to the function or candidate systems. In addition, in the analyst's judgment, the candidate systems could be equally good or bad within the rather broad scale provided. Should either of the above be the case, the particular effect, or effects, should be left blank.

Upon completion of the ranking, weights from Tables V-1 through V-4 (according to the region involved) are multiplied by the rankings and inserted for each effect. The scores for each function are then totaled in the last two columns and summed for total scores of Systems 1 and 2. For the example shown in Figure V-1, System 2 scored 13.35, compared to 19.24 for System 1. In this case, System 2 would be selected if performance scores and costs for the two systems had failed to provide a decision.

"A" scores for systems concepts can be used in two ways. They can provide an additional determinant in the final selection of the system to be synthesized or they can be applied only when performance score and cost comparisons fail to indicate a clear-cut superiority of one system over another. For this study, "A" scores have been developed for those postulated systems, falling within cost and performance limitations as shown in Section VIII.

C. SUMMARY

As with the Performance Scoring Procedure, the subjective nature of the "A" scores prevents any interpretation in terms of absolute effect on the environment caused by the physical aspects of solid waste management systems. The procedure does, however, provide a meaningful comparison of various postulated systems. Quantification of these environmental effects, based on subjective analysis, may not provide the preciseness usually associated with engineering evaluations; however, the use of these procedures presents the alternative that would normally be determined in a subjective fashion in a far more ordered manner.

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VI. OPERATING CONDITIONS

A. PURPOSE

The purpose of this section of the report is to delineate the existing and projected conditions under which a solid waste management system will be required to operate, and to define how the developed data establishes the operational boundaries for conceptual waste management systems in the Fresno Region.

B. PROCEDURES

The objective of several task assignments in the study program was to collect and collate pertinent data to establish and define the requirements for solid waste management in the Fresno Region. In establishing the "Operating Conditions" for the Fresno Region Waste Management System, the data and conclusions developed in the following listed work assignments were used.

1. Regional Physical Environment
2. Demographic Projections
3. Economic Projections
4. Land Use Projections
5. Laws and Ordinances Related to Solid Waste Systems
6. Governmental Relationships to Solid Waste Systems
7. Existing Solid Waste Loadings
8. Projected Solid Waste Loadings
9. Existing Solid Waste Management Systems
10. Technical State of Art and Advanced Concepts
11. Financial Resources
12. Resultant Practices, State Developed Standards and Criteria (Preliminary)

These assignments resulted in special reports, most of which appear either in the Appendix of the Interim Report or the appendix of the final report. This section provides a summary of the data developed in all of the above listed assignments.

C. ENVIRONMENTAL CONDITIONS

1. Geographical

The Fresno Region Study Area is the central portion of Fresno County as shown in the location reference map, Figure VI-1. It is approximately 48 miles east to west and about 35 miles north to south and contains about 770,000 acres.

The area is located in the flat section of the San Joaquin Valley and is drained by the San Joaquin and the Kings Rivers. Forty-three percent of the 770,000 acres is presently under irrigated cultivation of high return crops with another 39 percent used for irrigated pasture or native rangeland. The balance, except for about 52,000 acres under urban development, is vacant land.

The urban area mentioned above consists of the major metropolitan area of Fresno and Clovis, the cities of Sanger, Fowler, Selma, Reedley, Kingsburg, Parlier, Kerman, and Orange Cove, as well as the unincorporated communities of Biola, Del Rey, Laton, Easton, Calwa, Herndon, Malaga, Raisin City and others. (See Figure VI-2 for a detail map of the study region)

2. Geophysical

Fresno County is approximately 135 miles wide from southwest to northeast and varies from 30 to 60 miles deep in a northwest-southeast direction. It extends from the Coast Ranges on the southwest to the crest of the Sierra Nevada on the northeast (Figure VI-1). The elevation ranges from about 110 feet above sea level, where the San Joaquin River flows into Merced County, to over 4,000 feet in the Coast Ranges and up to

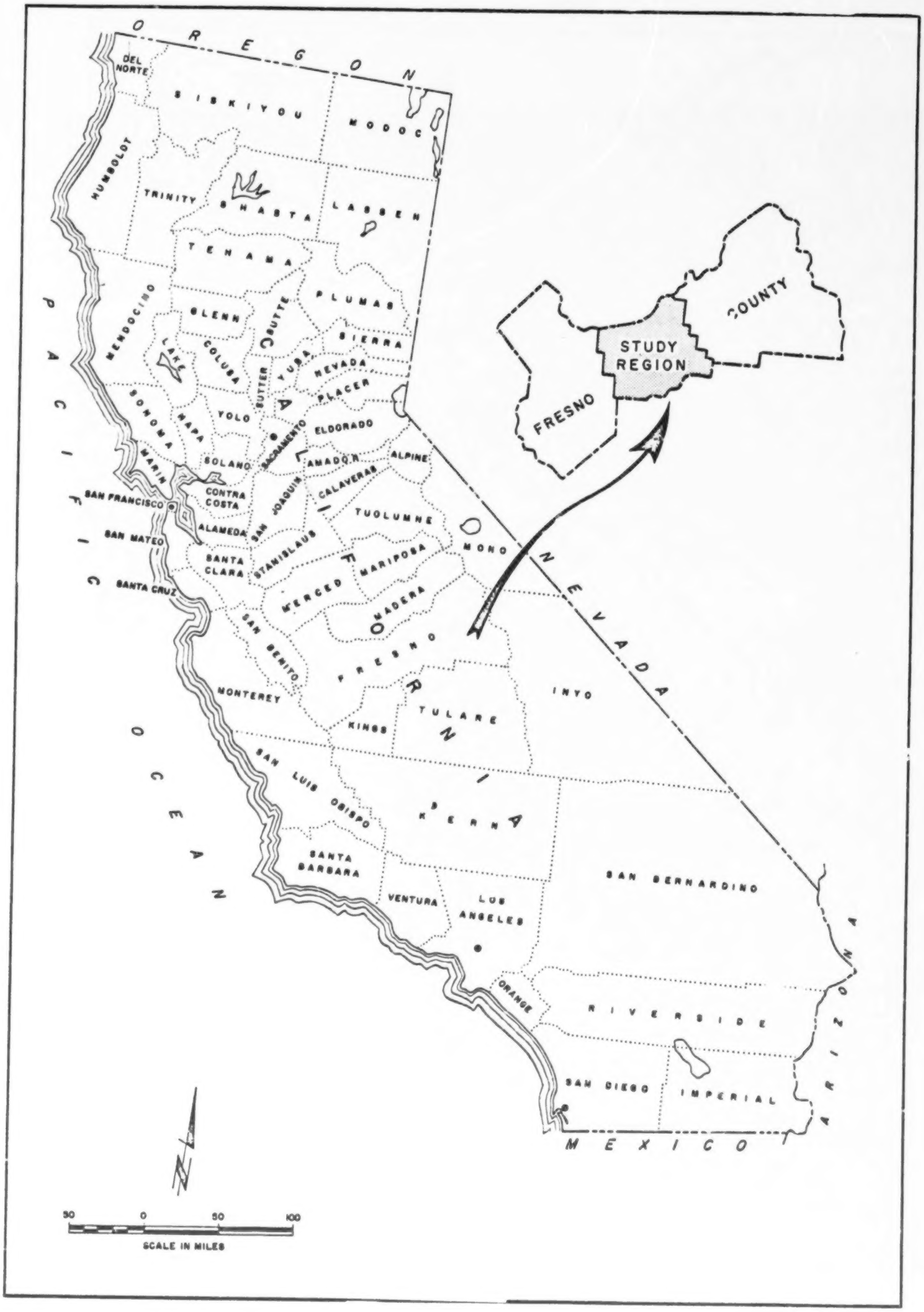

OREGON
DEL NORTE
SISKIYOU
MODOC
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
LAKE
COLUSA
SUTTER
YUBA
NEVADA
PLACER
YOLO
SONOMA
NAPA
SACRAMENTO
ELDORADO
ALPINE
MARIN
SOLANO
AMADOR
CALAVERAS
SAN FRANCISCO
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
ALAMEDA
SAN MATEO
MONO
SANTA CLARA
STANISLAUS
MARIPOSA
MERCED
SANTA CRUZ
MADERA
SAN BENITO
FRESNO
MONTEREY
INYO
KINGS
TULARE
SAN LUIS OBISPO
KERN
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
MEXICO
ARIZONA
NEVADA
CALIFORNIA
PACIFIC OCEAN
FRESNO
STUDY REGION
COUNTY
50 0 50 100
SCALE IN MILES

Figure VI-1. Location Reference Map of Study Region

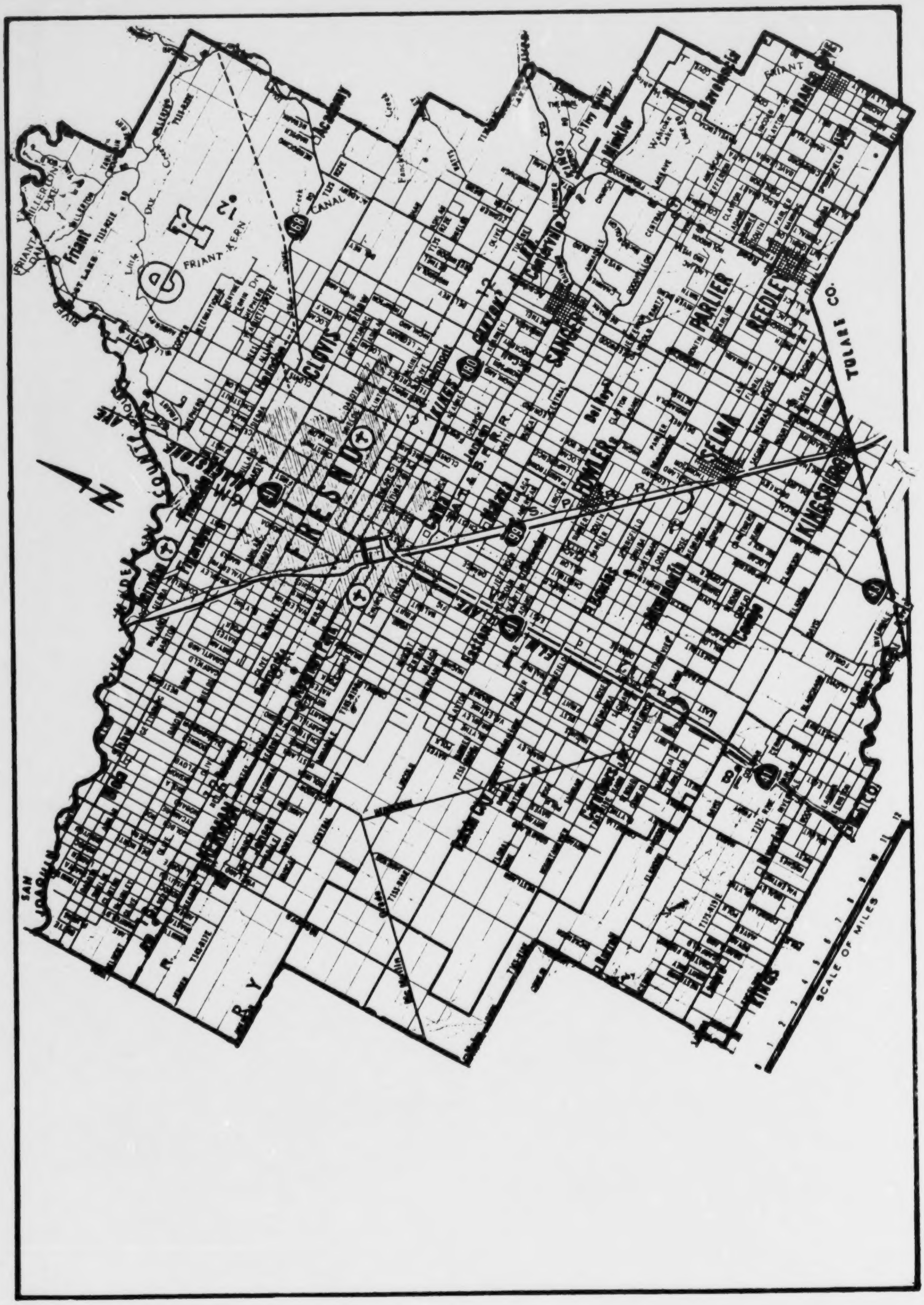

FRESNO
CLOVIS
SANGER
FOWLER
SELMA
PARLIER
REEDLEY
KINGSBURG
TULARE CO.
FRIANT-KERN CANAL
SAN JOAQUIN
KINGS
SCALE OF MILES

Figure VI-2. Fresno Region Study Area

over 14,000 feet at the crest of the Sierra Nevada. Between the two mountain systems lies the broad, flat San Joaquin Valley which is drained in part by the San Joaquin River. Within Fresno County, the valley is 50 to 60 miles in width. Deep soils of alluvial origin, abundant water for irrigation, and a long hot growing season make the valley one of the world's most productive agricultural regions and Fresno County the nation's leader in the value of its agricultural production.

From time to time, water has flowed the length of the San Joaquin Valley but now the huge alluvial delta of the Kings River effectively blocks northward flow of water under normal conditions. Most of the Kings River water has, for some years, drained into Tulare Lake which has no outlet. Tulare Lake is now gradually drying up as most of the water of the Kings River (as well as the San Joaquin River) is impounded during the winter months and spring to be used for irrigation during the dry summer months. There is still a water connection between the Kings and San Joaquin Rivers which is known as the Fresno Slough. This watercourse lies at the low point of the Valley in Fresno County and flows northward to the San Joaquin River.

The Fresno Region Study Area is located in the flat section of the valley and does not exhibit pointed topographical variations from one location to the other. The general slope of the land in this area is represented by a slight westerly decline of four to five feet per mile. This slope prevails to the east of Fresno Slough where it changes direction and becomes a westerly rise gradually reaching the coast range.

3. Climatology

While a wide variety of climatic conditions exist in the various parts of Fresno County, the study region in the flat section of the San Joaquin Valley is subject to hot, dry summers and moderate winters. Rainfall in the valley results from winter storms that move on-shore from Pacific low pressure systems, dropping their moisture in the San Joaquin Valley. The coast ranges insulate the valley from the modifying effect of the Pacific Ocean and, hence, the summer temperatures reach extremes found in mid-continental locations.

a. The precipitation pattern found within the County is profoundly influenced by topography. Moist air moving in from the Pacific rises as it passes over the coast ranges then flows downslope as it comes into the San Joaquin Valley. This forms a "rain shadow" east of the coast range where precipitation is very light. Moving eastward across the San Joaquin Valley, rainfall continues light until the lifting effect of the Sierra Nevada causes the warm air to cool and the moisture to condense and precipitate. In common with other areas of California, precipitation is concentrated in the winter — nearly 85 percent of the annual total is received in the six-month period from October through March.

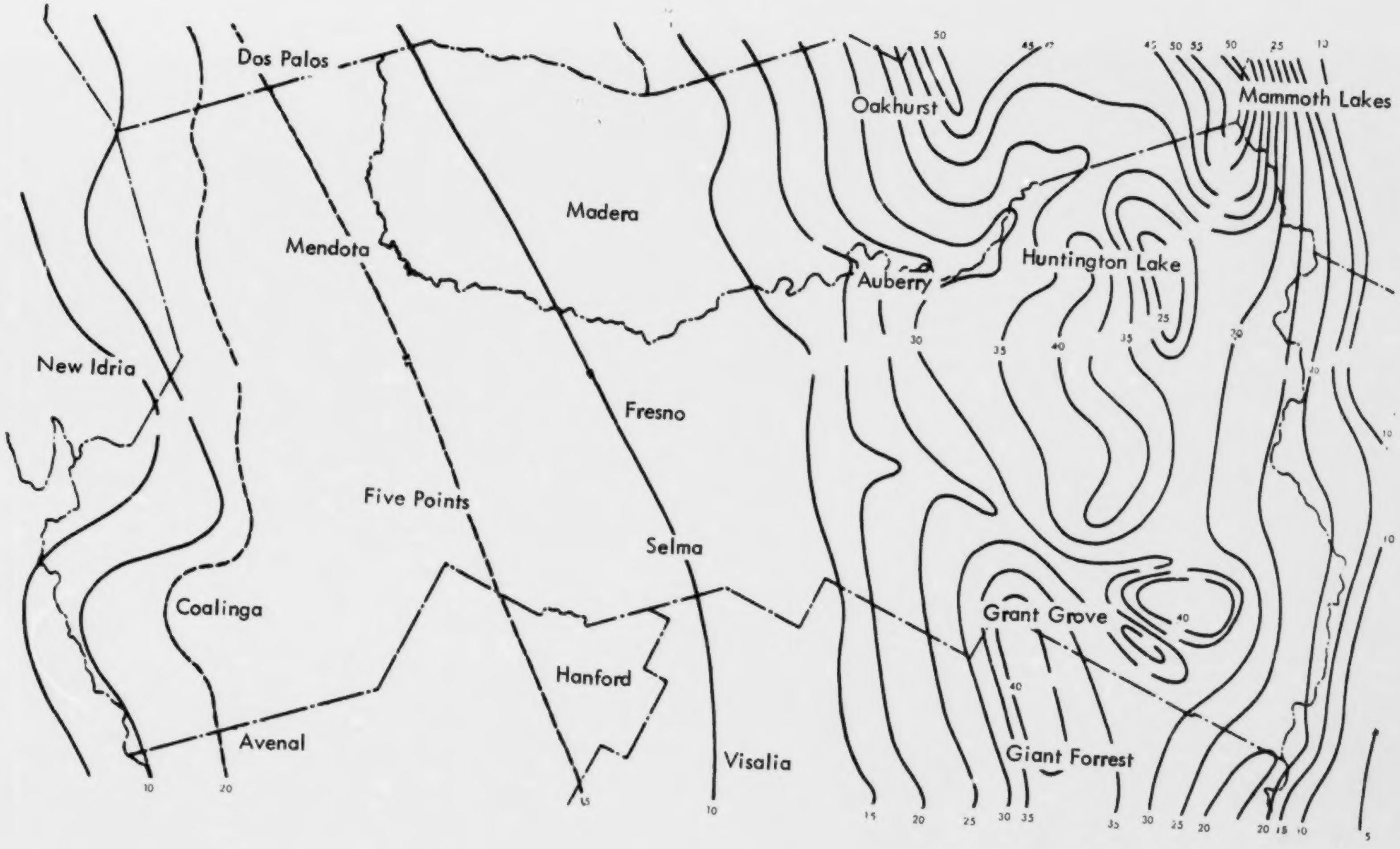
The patterns of annual precipitation throughout the County are illustrated in Figure VI-3. Below the 500-foot elevation the valley receives less than 15 inches annual precipitation. The driest areas are west of the Fresno Slough where annual totals average only 6 to 7 inches. The greatest precipitation in the valley occurs along the foothills on the east side, and there is a steady increase in precipitation as elevation increases. Grant Grove at 6,580 averages nearly 45 inches.

b. Temperature

Wide ranges of temperature exist within Fresno County. At low elevations, summers are hot while winter temperatures remain moderate.

Temperature, as well as precipitation, is related to topography; in general, average temperature decreases as altitude increases. There are some significant departures from this rule; since cold air drains to low spots, the low area of the valley along the Fresno Slough has minimum readings that are somewhat lower than slightly higher areas in the valley near the foothills where air drainage is better.

The July daily maximum temperature averages over 100°F in the west half of the valley and in the belt near the Sierra Foothills


Dos Palos
Oakhurst
Mammoth Lakes
Madera
Mendota
Auberry
Huntington Lake
New Idria
Fresno
Five Points
Selma
Coalinga
Grant Grove
Hanford
Avenal
Visalia
Giant Forrest
50
45
50
55
50
25
10
30
35
40
35
25
20
20
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10
40
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20
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35
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25
20
20
15
10
5

Figure VI-3. Average Annual Precipitation in Inches

extending for a distance up the river canyons. Extreme highs of 100° or more have been recorded up to 2,500 feet, with readings of 115° or higher reported from most stations below about 500 feet elevation. On the average, the Fresno Air Terminal observes 101 days per year with temperatures of 90° or higher.

The January mean daily minimum temperature is above freezing at most observation stations below 2,500 feet elevation. Readings average about 33° or 34° near the low point of the San Joaquin Valley, with bands of warmer temperatures extending along either side of the valley to an elevation of a few hundred feet. Certain areas within these warm zones are protected against frost on all but the coldest nights.

c. Wind

In open areas of the County the prevailing wind direction is from the northwest during most of the year, although southeasterly winds are more common during November, December and January. Wind direction in mountainous terrain is determined primarily by orographic characteristics and may come from almost any point of the compass. In general, there is a tendency for the air to move upslope during the day and to drain downslope at night. Occasionally, the area is visited by strong north winds that dry the soil and dessicate vegetation. These winds are usually of higher velocity and more gusty on the west side of the valley than on the east and some crop damage may be anticipated. The strongest winds appear to blow from the same directions as the prevailing winds: from the southeast during the winter and from the northwest during the rest of the year. Wind speed averages at Fresno are lowest in November, increasing to a maximum in June. Extreme wind speeds, on the other hand, are likely to be higher during winter storms than during the remainder of the year. Winds of 30 to 50 miles per hour may be expected about once every two years at low elevations while speeds up to 80 miles per hour may be experienced once in 50 years. Average year-round wind speed recorded at the Fresno Air Terminal varies between 4 and 8 miles per hour.

d. Relative Humidity

Relative humidity is fairly high during the winter months, but low readings are the rule during the rest of the year. Late summer and fall are particularly dry in this part of California. Relative humidity during January ranges from about 50 to 70 percent during the day to 90 percent at night at low elevations and averages from 85 to 95 percent in the mountains. Summer and early fall are likely to be very dry, afternoon readings frequently dropping below 15 percent in the valley and 25 to 35 percent in the mountains.

e. Sunshine

The County receives abundant sunshine during the summer of the year and moderate amounts at other times. In the months from June to September, the area experiences over 95 percent of possible sunshine based on the readings at the Fresno Air Terminal. This drops to half that amount during December and January. Considerably more sunshine is experienced just above the fog or low clouds that frequently envelop the valley during winter. Cumulus clouds reduce the summer figure in the mountains, though sunshine is likely for a good part of the day even when such clouds are present.

At Fresno, the average year contains 196 clear days, 74 partly-cloudy days, and 95 cloudy days. This is probably representative of conditions throughout the valley.

f. Smog

A study of the meteorology of all areas of the State by the Bureau of Air Sanitation indicated that the meteorology and climate of the San Joaquin Valley are unusually favorable for the development of air pollution. Light winds and atmospheric stability provide a frequent opportunity for pollutants to accumulate in the atmosphere. The general circulation, characterized by daily up-valley and down-valley winds that shift back and forth over the valley floor, permits the transport of pollution over long distances along the axis of the valley. Although meteorological conditions can produce a high air pollution potential at any time of the year, air pollution is most likely to occur in the fall and winter. The possibility of photochemical smog formation in the summer and fall is enhanced by the almost unbroken succession of warm, clear days during these seasons. Air pollution problems which may be local in nature or cover considerable areas result from dust, smoke, odors, and specific chemicals.

Photochemical smog is caused by the reaction of hydrocarbons and oxides of nitrogen under the influence of sunlight. While motor vehicles are the principal source of both the hydrocarbons and oxides of nitrogen in the San Joaquin Valley and Fresno County, agricultural, commercial, and industrial operations and refuse burning also contribute a large share of hydrocarbons and oxides of nitrogen to the atmosphere. During the fall, the burning of agriculture crop wastes becomes a highly significant factor in the region's pollution problem.

The oxidant index is the most widely accepted measure of the occurrence and intensity of photochemical air pollution. The State Department of Public Health in 1959 set a standard for the oxidant index at 0.15 parts per million (ppm) for one hour as the level at which eye irritation, haze and plant damage might be expected to occur. Fresno exceeded this standard a number of times in recent years: 9 times in 1963, 5 times in 1964, and 34 times in 1965.

4. Hydrology

The distribution and migration of the area surface and groundwater supplies is an extremely important aspect of the area operating conditions with respect to a waste management system.

Information on the state of groundwater is essential in the selection and design of sanitary landfills and other solid waste disposal sites. Landfills, if not properly located, may contribute to the degradation of groundwater either by direct percolation of leachates to the groundwater or by interaction of CO_2 generated in the landfill from the decomposition of solid wastes with the groundwater. Likewise, surface runoff and high water table drainage from solid waste residues, if not controlled, can appreciably degrade the area's runoff streams.

a. Surface Waters

There are two main surface streams in the Fresno Region: the San Joaquin and Kings Rivers.

The San Joaquin River originates in the Sierra Nevada mountains and flows along the boundary line between Fresno and Madera Counties. The flow of this river is gaged below Friant, California, and has a 58-year average discharge of 2,306 cfs or 1,669,000 ac-ft/yr. The flow of this river is regulated by Millerton Lake.

The Kings River also originates in the Sierra Nevada mountains and, at a station below Pine Flat Reservoir, has a 12-year average discharge of 1987 cfs or 1,439,000 ac-ft/yr. The flow of this river is regulated by Pine Flat Reservoir. This river passes through the southeast part of Fresno County and flows into Tulare and Kings Counties toward the Tulare Lake Bed (Figure VI-4).

These two rivers constitute the only natural sources of surface water supply in the Fresno Region. Both of these rivers have water of excellent quality.

b. Groundwater

Groundwater is the main source of water supply in the Fresno Region. The municipal, domestic and industrial water supply for the Fresno-Clovis Metropolitan Area is obtained entirely from the groundwater. Agricultural water requirements in the county are also supplemented by the use of groundwater and, in some areas, groundwater is the only source of such supply.

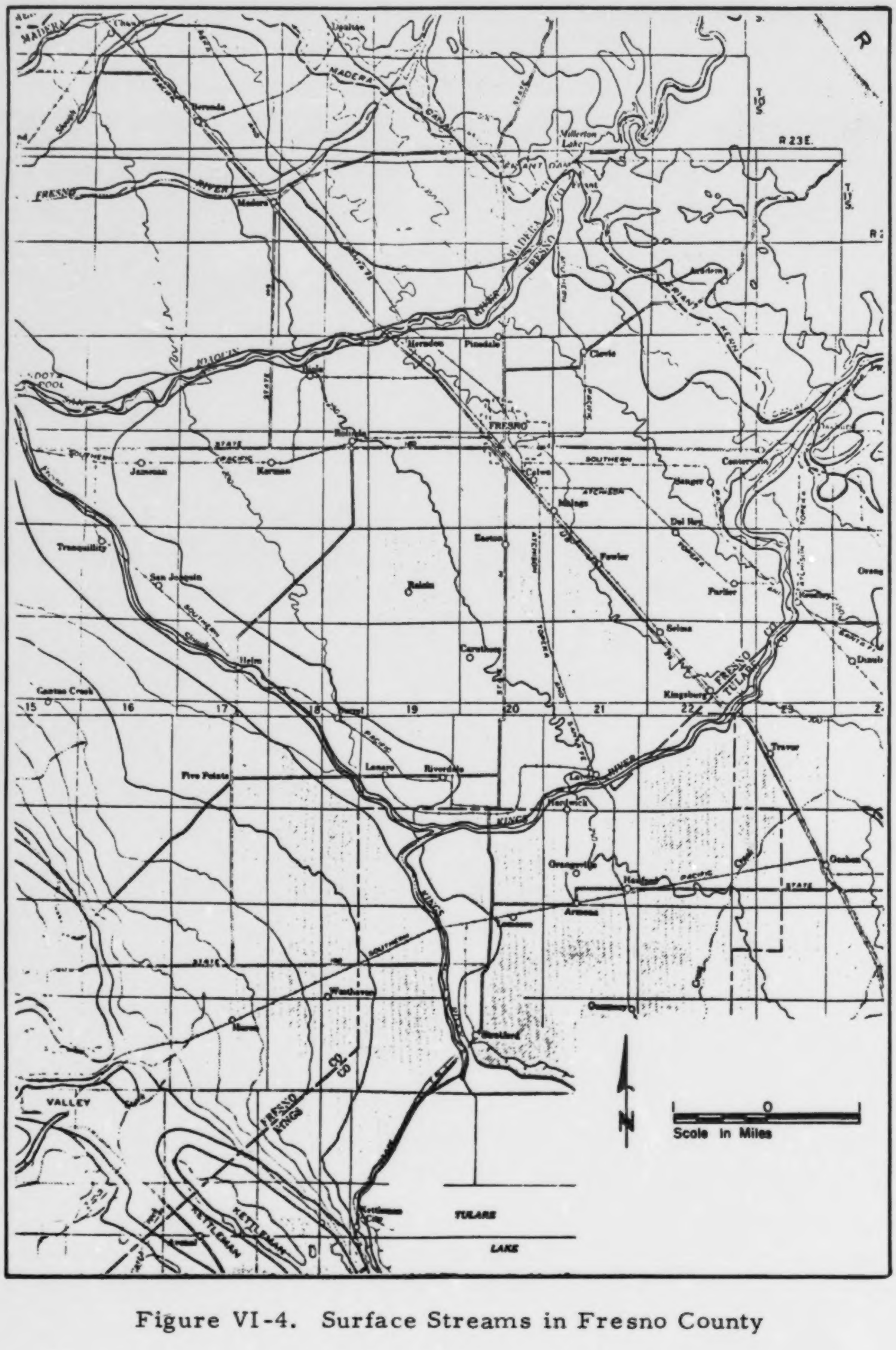

MADERA
Berenda
Millerton Lake
FRIANT DAM
R 23 E.
T 10 S.
T 11 S.
FRESNO RIVER
Madera
MADERA CANAL
SAN JOAQUIN RIVER
Herndon
Pinedale
Clovis
FRESNO
Jameson
Kerman
Calwa
Malaga
Sanger
Centerville
Del Rey
Easton
Fowler
Parlier
Reedley
Raisin
Tranquillity
San Joaquin
Selma
Caruthers
Helm
Kingsburg
FRESNO
TULARE
Cantua Creek
15
16
17
18
19
20
21
22
23
Traver
Five Points
Lanare
Riverdale
Laton
KINGS RIVER
Hardwick
Grangeville
Hanford
Goshen
Armona
Lemoore
Westhaven
Huron
Guernsey
Stratford
VALLEY
FRESNO
KINGS
Kettleman City
KETTLEMAN
TULARE
LAKE
N
0
Scale in Miles

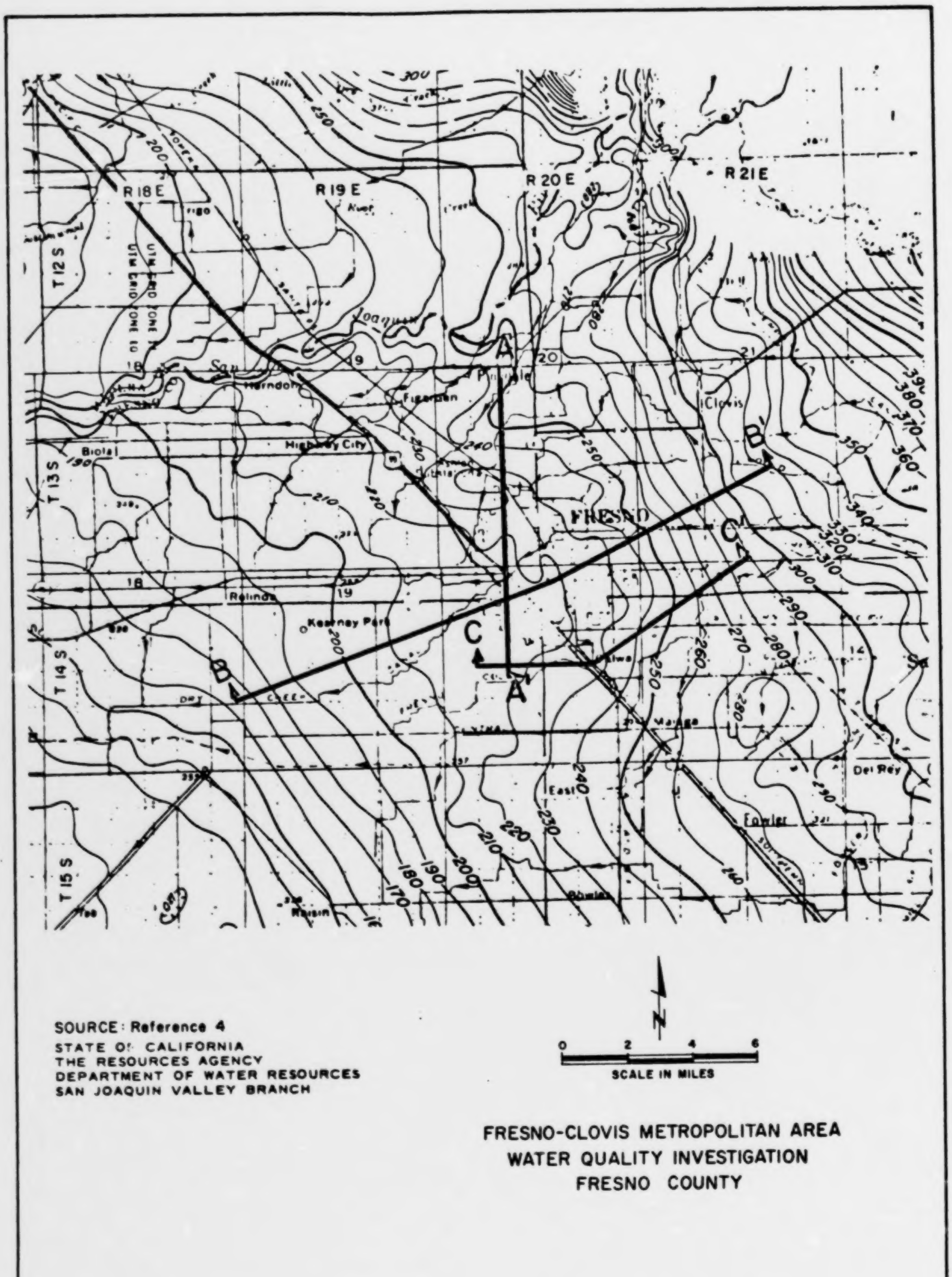
Figure VI-4. Surface Streams in Fresno County

Historically, groundwater has been found throughout the region. The depth to the groundwater in Fresno County in 1952 was between 10 and 50 feet but during the past 15 years the use of groundwater has increased on an accelerated basis until the present depth to groundwater is about 70 feet in the Fresno-Clovis Metropolitan Area.

During the last ten years, the decline of water levels has averaged three feet per year. Figure VI-5 illustrates groundwater elevations in and around the metropolitan area (spring 1963).

In 1915, the water table beneath the Fresno-Clovis area had a fairly even southwesterly gradient averaging about eight feet per mile (0.0015). Although the regional water table still maintains its general southwesterly gradient, heavy pumping in the Fresno area, together with insufficient recharge, has modified the historical configuration. The gradient now dips south from Pinedale toward the heart of Fresno and nearly due west from the City of Calwa. Between Fresno and Clovis the gradient remains southwesterly but has increased from 8 feet per mile to about 20 feet per mile. Southwest of Fresno the gradient has become very flat with a minimum of about one-half foot per mile (Spring 1963). Should this trend continue, it is possible that a "pumping depression" may eventually develop beneath Fresno, resulting in a reversal of the gradient in the area southwest of the city.

In the vicinity of Fresno, average permeabilities vary from 135 to 820 gallons per day per square foot. The average for the Fresno-Clovis Metropolitan Area is approximately 620 gallons per day per square foot. The highest local permeabilities were found in the channels and fans of the small, active drainages such as Dry Creek, Dog Creek, Fancher Creek, and Redbank Slough; the highest average permeability was in Township 14 South, Range 21 East, and reflects the high permeability of the young alluvium of Fancher Creek and Redbank Slough.


R18E
R19E
R20E
R21E
T12S
T13S
T14S
T15S
FRESNO
Clovis
Herndon
Highway City
Biola
Rolinda
Kearney Park
Malaga
Fowler
Del Rey
Bowles
Raisin
A
A
B
B
C
C
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
380
390
0
2
4
6
SCALE IN MILES

SOURCE: Reference 4
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

FRESNO-CLOVIS METROPOLITAN AREA
WATER QUALITY INVESTIGATION
FRESNO COUNTY

Figure VI-5. Lines of Equal Elevation of Ground Water (Spring 1963)

Groundwater recharge in the area is affected by the complex interconnected nature of the permeable units in the underlying deposits and the existence of less permeable layers.

A layer of hardpan at a depth of five to ten feet is frequently encountered in the old alluvium found throughout most of the Fresno area. Although downward movement of water is impeded by the hardpan, percolation does occur at an estimated rate of one to three gallons per day per square foot. In certain suburban areas, percolation is enhanced by septic tank leach wells which penetrate the hardpan to reach underlying, more permeable sands.

Most recharge occurs in the Fresno-Clovis area through the young alluvium deposits of intermittent streams entering the area from the east, through percolation and infiltration from ponds associated with sewage treatment facilities, and through the canal systems and ponding sites. The Fresno Irrigation District estimates that approximately 50 percent of the water conveyed by its canals is lost by seepage before delivery. At the end of the irrigation season, the canal system and ponding sites of the Fresno Irrigation District are sometimes used as recharge facilities. Numerous other small recharge facilities are located throughout the area and are operated by other agencies.

In general, the groundwater quality in the metropolitan area is very good. Table VI-1 presents the maximum, minimum, mean, and median concentration values of the constituents in the area's groundwater samples. Generally, the higher values were obtained from the area surrounding the Fresno Sewage Treatment Plant and from three wells located in the vicinity of the Pacific Fruit Express ice plant and the abandoned Southern Pacific zeolite water softening plant.

Extremely high mineral concentrations in the vicinity of the ice plant and water softening plant prompted an investigation in 1953 by the Division of Water Resources of the State Department of Public Works.

Table VI-1

SUMMARY OF GROUND WATER QUALITY ANALYSES
FRESNO-CLOVIS METROPOLITAN AREA

Mineral Constituents in Parts Per Million (ppm)		Maximum	Mean	Median	Minimum
pH		9.2	7.8	7.8	7.3
Calcium	(Ca)	108	27	20	2.4
Magnesium	(Mg)	53	13	11	0.0
Sodium	(Na)	112	21	16	5.6
Potassium	(K)	13	4.7	4.3	1.5
Sulfate	$(S0_4)$	22	9.4	7.2	0.0
Chloride	(C1)	94	20.6	12.0	1.9
Fluoride	(F)	0.4	0.13	0.1	0.0
Nitrate	$(N0_3)$	58.5	15.1	13.0	0.8
Boron	(B)	0.34	0.1	0.07	0.00
Silica	$(Si0_2)$	102	64	67	23
Alkalinity	$(HC0_3)$	585	144	110	39
Dissolved Solids		708	268	220	86
Total Hardness as	$CaC0_3$	384	127	100	44
Alkyl Benzene Sulfonate	(ABS)	0.3	< 0.1	0.0	0.0

Corrective measures taken at the conclusion of that investigation have improved the groundwater quality; however, the water is still of a lower quality than that of the surrounding area.

Figure VI-6 is a plot of three ranges of dissolved-solids concentration in water from wells in the Fresno-Clovis area. The pattern for total hardness follows closely that of the concentration of dissolved solids.

Nitrate concentrations in groundwater in the central portion of the San Joaquin Valley average approximately 11 ppm, whereas the average in the area of investigation is 15 ppm. Figure VI-7 shows three ranges of nitrate concentrations exist in the area southwest of the Fresno Air Terminal and in the vicinity of the Fresno Sewage Treatment Plant. The area southwest of the air terminal lies outside the Fresno City limits and is an unsewered region. Many wells located in these areas have nitrate concentrations near or above the drinking water standards of 45 ppm. Most of the higher concentrations were found in shallower wells.

D. DEMOGRAPHY

To facilitate presentation, the study region was divided into 15 zones in the demographic study conforming to the existing systems of census tracts and enumeration districts. For the purposes of this report these zones will be named after the major city or town in the zone and are as follows: Biola, Caruthers, Del Rey, Fowler, Kerman, Kingsburg, Laton, Orange Cove, Parlier, Reedley, Riverdale, Sanger, Selma, Foothill, and F. C. M. A. (Fresno-Clovis Metropolitan Area). Figure VI-8 delineates the geographic areas alloted to each of the above zones. It should be noted that the zone called Foothill is named for its geographic position rathar than for a community.

The present and projected population for the study region and for each of the above zones is presented in Table VI-2. The population is

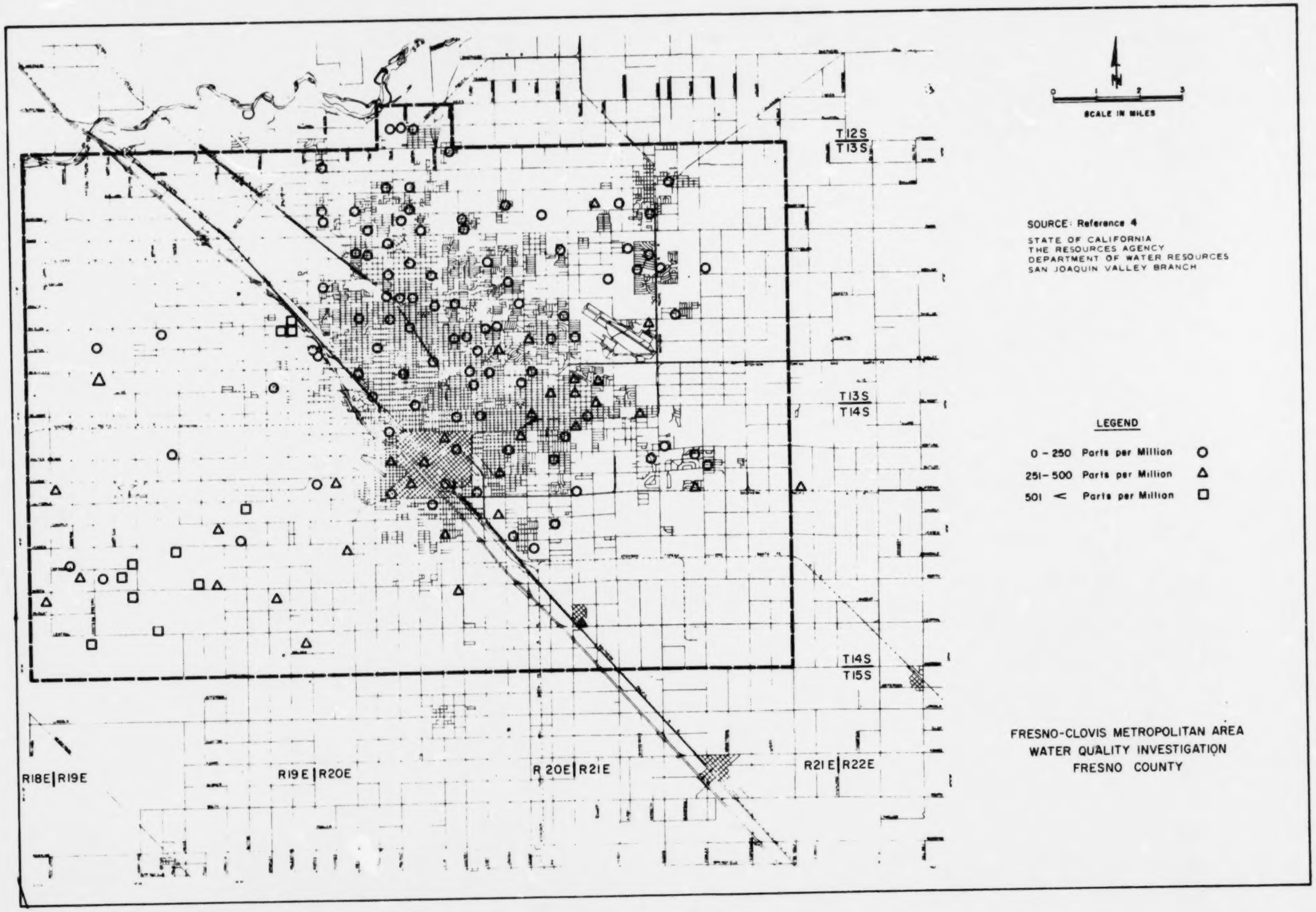

0 1 2 3
SCALE IN MILES
T12S
T13S
T13S
T14S
T14S
T15S
SOURCE: Reference 4
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
LEGEND
0 - 250 Parts per Million ○
251 - 500 Parts per Million △
501 < Parts per Million □
FRESNO-CLOVIS METROPOLITAN AREA
WATER QUALITY INVESTIGATION
FRESNO COUNTY
R18E|R19E
R19E|R20E
R20E|R21E
R21E|R22E

Figure VI-6. Concentration of Dissolved Solids (1963)

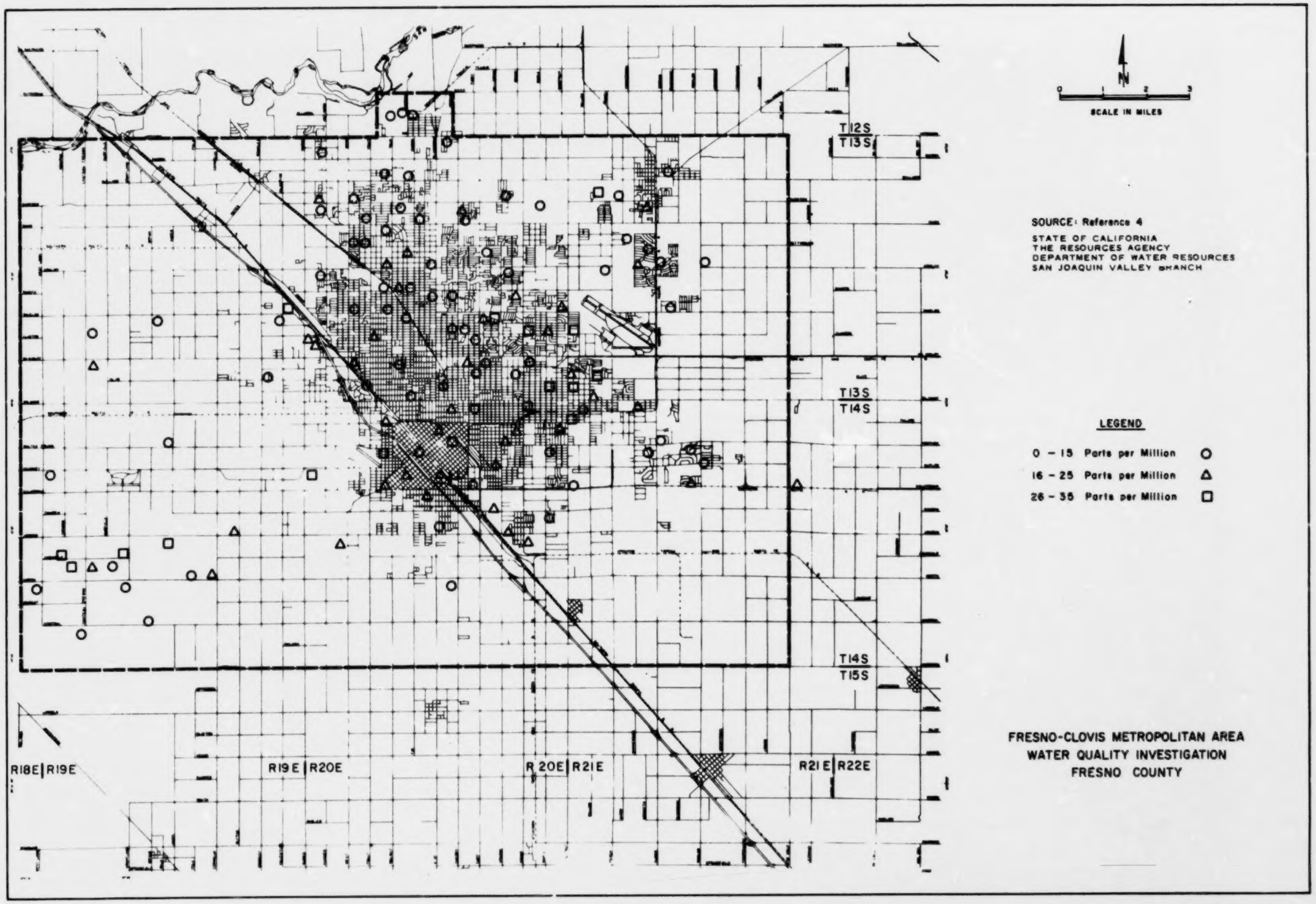

SCALE IN MILES
0
1
2
3
N
SOURCE: Reference 4
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
LEGEND
0 – 15 Parts per Million ○
16 – 25 Parts per Million △
26 – 35 Parts per Million □
FRESNO-CLOVIS METROPOLITAN AREA
WATER QUALITY INVESTIGATION
FRESNO COUNTY
T12S
T13S
T13S
T14S
T14S
T15S
R18E R19E
R19E R20E
R20E R21E
R21E R22E

Figure VI-7. Concentration of Nitrates as NO_3 (1963)

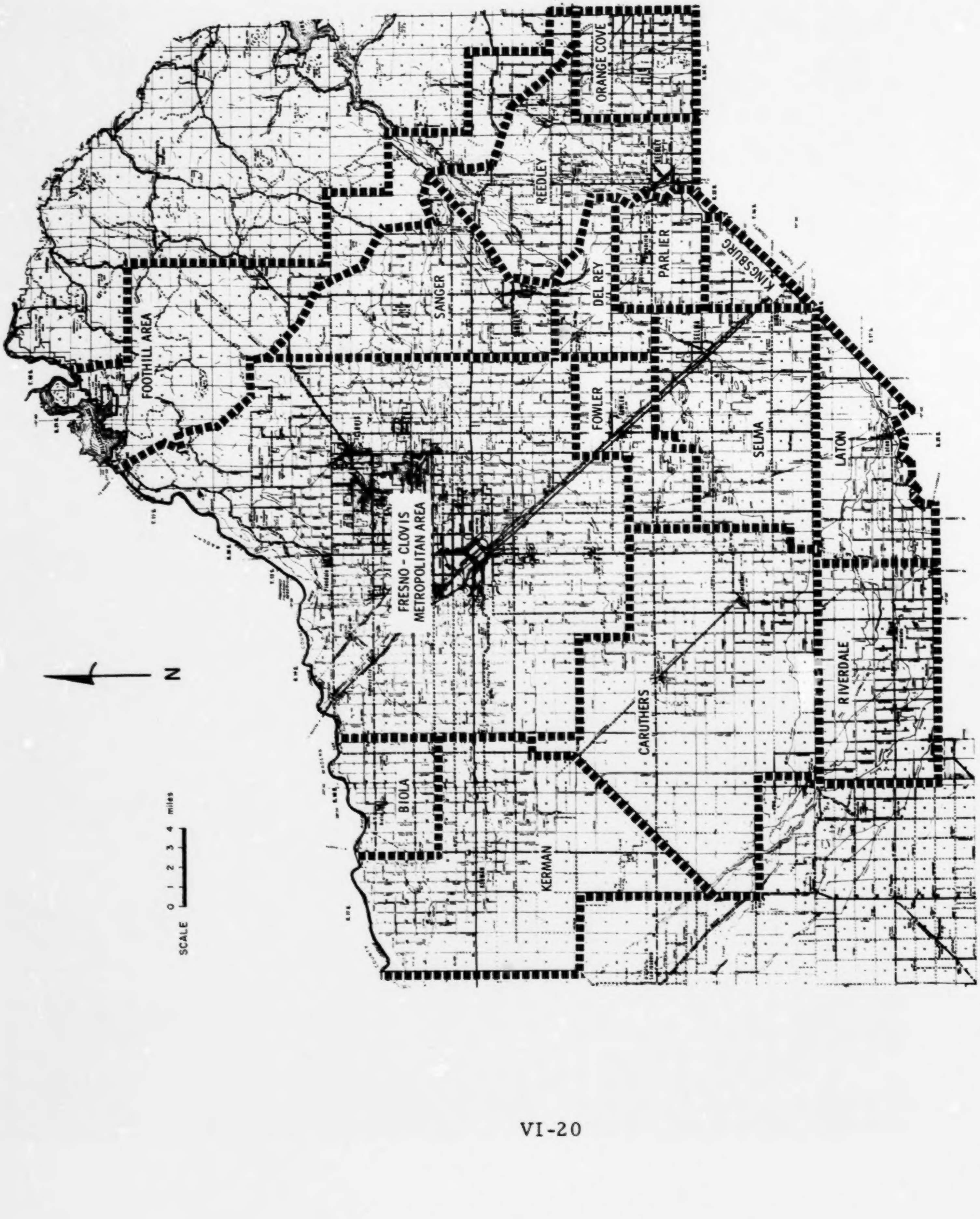

FOOTHILL AREA
SANGER
REEDLEY
ORANGE COVE
DEL REY
PARLIER
KINGSBURG
FOWLER
SELMA
LATON
FRESNO - CLOVIS METROPOLITAN AREA
RIVERDALE
CARUTHERS
KERMAN
BIOLA
N
SCALE
0 1 2 3 4 miles

Figure VI-8. Fresno Region Zonal Boundaries

Table VI-2

FRESNO REGION POPULATION PROJECTIONS AND DISTRIBUTION

	Biola				Caruthers				Del Rey			
	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000
Community	704	812	907	1,013	947	1,067	1,170	1,283	1,019	1,190	1,342	1,513
Area	1,814	1,964	2,088	2,220	6,834	8,253	9,546	11,042	1,628	1,772	1,892	2,020
Total	2,518	2,776	2,995	3,233	7,781	9,320	10,716	12,325	2,647	2,962	3,234	3,533

	Fowler				Kerman				Kinsburg			
	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000
Community	2,346	3,472	4,703	6,369	3,021	6,480	11,753	21,317	3,253	5,038	6,429	8,203
Area	3,183	3,500	3,765	4,059	5,687	6,481	7,164	7,919	1,561	1,735	1,840	1,951
Total	5,529	6,972	8,468	10,420	8,708	12,961	18,917	29,236	4,814	6,773	8,269	10,154

	Laton				Orange Cove				Parlier			
	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000
Community	1,139	1,317	1,474	1,649	3,589	5,339	7,263	9,880	1,822	3,067	4,595	6,884
Area	1,486	1,696	1,877	2,078	1,033	1,056	1,074	1,093	4,864	5,375	5,805	6,269
Total	2,625	3,013	3,351	3,727	4,622	6,395	8,337	10,973	6,686	8,442	10,400	13,153

	Reedley				Riverdale				Sanger			
	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000
Community	8,004	11,772	15,872	21,400	1,590	3,550	6,648	12,451	9,942	14,877	20,330	27,784
Area	5,217	5,670	6,029	6,411	2,540	3,600	4,710	6,160	5,245	5,908	6,476	7,098
Total	13,221	17,442	21,901	27,811	4,130	7,150	11,358	18,611	15,187	20,785	26,806	34,882

	Selma				Foothill				F. C. M. A.			
	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000
Community	7,752	11,008	14,442	18,947					266,623	421,554	595,919	834,601
Area	8,786	10,622	12,298	14,237	694	821	947	1,099	34,704	30,175	21,485	10,564
Total	16,538	21,630	26,740	33,184	694	821	947	1,099	301,237	451,729	617,404	845,165

	Study Area			
	1967	1980	1990	2000
Community	311,751	490,543	692,847	973,294
Area	84,425	87,657	85,882	83,113
Total	396,176	578,200	778,729	1,056,407

delineated for each zone and is divided into numbers of persons residing or projected to be residing in communities and numbers in the area outside the communities. Data is presented for the years 1967, 1980, 1990, and 2000.

E. LAND USE

1. Agriculture

Agriculture is by far the biggest industry at present in Fresno County and Fresno County tops all other counties in the U.S. in the value of agricultural crops produced. The study region currently produces about 70 percent of the income from agriculture in Fresno County.

The study region has an area of 770,000 acres of which 43 percent is already producing high return crops such as fruit and nuts, field crops, vegetables, etc., and another 39 percent is presently used for irrigated pasture, alfalfa hay, or native rangeland. The balance of this area, except for 52,000 acres under urban development, is vacant land which is either unsuitable for farming due to salinity problems or is idle due to the lack of an economical source of irrgiation water.

Approximately 450,000 acres of irrigated land is farmed in this region. Grapes occupy the largest acreage for a single crop, 157,000 acres, with cotton second at 39,000 acres. Other crops such as barley, cantaloupe, sugar beets, figs, peaches, oranges, and seed alfalfa are raised in the area with acreages varying from 21,000 to 10,000 acres, respectively. A number of other crops such as tomatoes, sorghum, plums, corn, nectarines, almonds, and walnuts are produced with acreages in the range of 4,500 to 2,000 acres. In addition, some minor crops such as olives, apricots, lemons, bushberries, pomegranates, prunes, persimmons, oats, onions, wheat, peppers, squash, sweet corn, beans, etc., are produced on plots not exceeding several hundred acres.

The approximate present acreage of different agricultural crops in the study area by crop and zone is shown in Table VI-3. This table does not include the acreage of pasture, rangelands, and hay alfalfa which comprise an approximate area of 70,000, 90,000, and 140,000 acres, respectively.

Table VI-3

FRESNO REGION MAJOR AGRICULTURAL CROP ACREAGE (1967)

Crop	Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	Foothill	FCMA	Region
Barley, Oats	--	--	1,001	10	163	417	187	--	17	292	532	3,455	376	1,801	12,325	20,576
Cantaloupes	98	--	7,948	15	389	308	2,810	400	25	225	1,950	115	4,380	174	677	19,514
Sugar Beets	--	--	11,328	--	36	1,654	328	--	--	--	1,449	--	382	--	316	15,493
Cotton	50	560	9,850	74	411	8,753	3,336	295	105	452	2,313	1,239	2,752	173	6,703	39,066
Tomatoes	44	--	507	52	74	70	470	92	134	313	1,213	312	560	206	377	4,424
Seed Alfalfa	500	500	2,000	500	500	1,000	500	500	500	1,000	--	2,000	--	--	500	10,000
Sorghum	10	--	617	44	12	536	26	75	43	88	177	195	182	174	1,549	3,728
Corn	153	--	103	40	37	81	973	69	95	70	406	16	740	24	212	3,019
Onions	--	--	--	--	--	--	34	--	--	--	8	--	--	--	--	42
Wheat	--	--	--	--	--	3	--	--	--	--	--	12	--	15	108	138
Lettuce	--	--	--	--	--	--	--	--	--	18	--	41	13	26	17	115
Other Vegetables	5	--	149	7	4	--	162	125	11	125	161	41	167	--	6	963
Sub Total	860	1,060	33,503	742	1,626	12,822	8,826	1,556	930	2,583	8,209	7,426	9,552	2,593	24,790	117,078
Grapes	4,470	10,080	17,560	6,490	12,770	13,520	1,210	4,110	7,610	9,900	58	10,000	23,900	1,508	33,850	157,036
Figs	--	17	--	--	--	3	--	--	--	--	--	1,390	--	559	13,120	15,089
Peaches	531	18	239	1,086	1,112	12	686	682	1,430	1,574	17	1,389	1,430	282	5,540	16,028
Citrus	90	--	--	409	83	--	30	3,415	666	2,179	--	1,757	100	1,663	1,881	12,273
Plums	159	96	46	210	168	24	41	273	350	341	--	161	298	12	1,022	3,201
Nectarines	--	--	74	348	167	--	16	319	415	373	--	242	413	8	438	2,813
Almonds	39	--	152	126	47	--	59	95	75	72	50	201	164	25	1,290	2,405
Walnuts	49	--	37	431	173	--	20	19	44	223	--	312	336	23	359	2,026
Olives	227	--	--	21	1	--	--	88	2	99	--	82	1	48	96	665
Other Fruit Trees	--	--	--	--	--	--	281	--	--	--	55	--	55	--	11	402
Sub Total	5,565	10,211	18,118	9,121	14,521	13,559	2,343	9,001	10,592	14,761	180	15,534	26,697	4,128	57,607	211,938
Grand Total	6,425	11,271	51,621	9,863	16,147	26,381	11,169	10,557	11,522	17,344	8,389	22,960	36,249	6,721	82,397	329,016

Table VI-4

FRESNO REGION PROJECTED AGRICULTURAL CROP ACREAGES BY ZONES FOR 1980

	ZONE															
Crop	Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	Foothill	FCMA	Region
Barley, Oats	--	--	1,100	110	150	480	2,000	--	200	340	610	3,930	140	2,070	14,100	25,240
Cantaloupes	125	--	10,000	145	370	370	2,800	480	30	270	2,300	135	5,100	210	800	23,135
Sugar Beets	--	--	18,000	--	50	2,300	500	--	--	--	2,420	--	640	--	530	24,940
Cotton	85	1,020	17,600	1,000	730	15,700	5,000	530	190	810	4,130	2,230	4,810	310	15,100	69,245
Tomatoes	225	--	280	290	420	390	2,200	520	760	1,760	6,800	1,780	3,120	1,100	2,100	21,745
Seed alfalfa	680	680	2,900	680	680	2,900	680	680	680	1,400	--	2,900	--	--	--	14,860
Sorghum	15	--	900	100	25	800	40	55	80	130	270	290	270	260	2,300	5,535
Corn	350	--	230	1,000	85	190	2,000	150	220	160	950	35	1,750	55	595	7,780
Onions	--	--	--	--	--	--	60	--	--	--	150	--	75	75	175	535
Wheat	--	--	--	--	--	5	--	--	--	--	--	15	--	20	130	170
Lettuce	--	--	200	50	--	--	50	200	200	335	--	380	225	150	135	1,925
Other Vegetables	40	--	350	20	10	--	200	--	30	35	45	115	350	--	150	1,345
Sub Total	1,520	1,700	51,560	3,395	2,530	23,635	15,530	2,625	2,390	5,240	17,675	11,810	16,480	4,250	36,115	196,455
Grapes	5,100	11,500	20,100	6,865	14,500	15,500	13,500	4,700	8,300	11,500	5	2,900	27,000	1,700	39,000	182,170
Figs	--	15	--	--	--	5	--	--	--	--	--	1,300	--	550	13,000	14,870
Peaches	820	5	390	1,400	1,820	20	1,150	1,100	2,000	2,600	30	2,300	2,350	465	9,050	25,500
Citrus	130	--	--	500	120	--	40	4,650	935	3,100	--	2,500	150	2,350	2,650	17,125
Plums	295	185	85	300	310	45	75	510	650	635	--	300	555	200	1,900	6,045
Nectarines	--	--	130	450	285	--	25	535	715	640	--	425	720	15	755	4,695
Almonds	165	--	650	260	200	--	235	380	200	300	200	850	650	100	5,150	9,340
Walnuts	85	--	60	70	290	--	35	35	75	375	--	520	560	40	600	2,745
Olives	225	--	--	20	--	--	--	80	--	90	--	75	--	35	85	610
Other Fruit Trees	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	1,500
Sub Total	6,920	11,805	21,515	9,965	17,625	15,670	15,160	12,090	12,975	19,340	335	11,270	32,085	5,555	72,290	264,600
Grand Total	8,440	13,505	73,075	13,360	20,155	39,305	30,690	14,715	15,365	24,580	18,010	23,080	48,565	9,805	108,405	461,055

Because of the extreme dependence of agriculture on external market variations and changes in Federal agricultural control policies, only approximations are possible on projections of the various crop acreages in the years 1980, 1990 and 2000. In general, however, new agricultural lands in the study region will be brought under cultivation when water becomes available from the San Luis and Eastside Aqueduct projects. These developments will occur mainly in the east and west sides with minor developments taking place in the central part of the county.

During the project period it is expected that the entire reserve of agricultural land will be brought under production, that acreages of pasture and alfalfa hay will decrease, and the lands engaged by these crops will be used for other more profitable crops. At the same time, some agricultural lands of the highest quality will be lost to urban development.

In general, only small increases in acreage are expected for grapes, cantaloupes, barley, and olives, reduced acreage for figs, and substantial increases for all other major crops. Tables VI-4, 5, and 6 indicate the expected major crop acreages in the various zones in the years 1980, 1990, and 2000, respectively; Table VI-7 delineates the present and projected total agricultural acreage devoted to major crops in each zone.

Livestock, dairy and poultry operations have shown substantial increases in the county and may continue to grow in the future. Sixteen full-time feedlots exist in the county with a capacity to finish in excess of 300, 000 cattle each year. The 1966 beef cattle production of the county amounted to 240, 000 head. The majority of these feedlots are located in the study region and use approximately 1, 200 acres. The trend of these feedlots is an increasing one, although hampered somewhat by the local (California) high cost of grain.

Sheep and hogs are also raised in the study region and number about 20, 000 ewes and some 7, 000 to 8, 000 hogs. Sheep are being

Table VI-5

FRESNO REGION PROJECTED AGRICULTURAL CROP ACREAGES BY ZONES FOR 1990

	ZONE															
Crop	Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	Foothill	FCMA	Region
Barley, Oats	--	--	1,000	110	160	435	2,000	--	200	300	550	3,560	130	1,900	12,800	23,145
Cantaloupes	125	--	11,000	145	370	500	2,800	525	30	295	2,550	500	5,500	230	890	25,460
Sugar Beets	--	--	22,000	--	50	3,300	500	--	--	--	2,900	500	700	500	635	31,085
Cotton	85	1,200	23,000	1,000	730	18,500	5,000	620	190	950	4,850	2,610	5,000	365	18,300	82,400
Tomatoes	225	--	320	290	420	440	2,200	580	760	1,950	7,600	2,000	3,200	1,290	2,360	23,635
Seed Alfalfa	680	745	3,150	680	680	3,150	680	745	680	1,500	--	3,150	--	2,000	—	17,840
Sorghum	15	--	1,050	100	25	935	40	130	80	155	310	340	300	305	2,710	6,495
Corn	350	--	300	1,000	85	250	2,000	210	220	200	1,190	50	2,000	70	625	8,550
Onions	--	--	—	--	--	--	60	--	--	--	200	200	100	120	200	880
Wheat	—	--	--	--	--	5	--	--	--	--	--	10	--	15	110	140
Lettuce	--	--	300	50	--	--	50	300	200	450	--	750	250	225	200	2,775
Other Vegetables	40	--	600	20	10	--	200	--	30	55	70	200	400	500	250	2,375
Sub Total	1,520	1,945	62,720	3,395	2,530	27,515	15,530	3,110	2,390	5,855	20,220	13,870	17,580	7,520	39,080	224,780
Grapes	5,100	12,500	22,000	6,865	14,500	19,000	13,500	5,150	8,300	12,600	5,000	5,000	25,745	4,000	42,200	201,460
Figs	--	15	--	—	—	1,000	--	--	--	--	--	1,260	--	495	11,500	14,270
Peaches	820	5	460	1,400	820	--	1,150	1,280	2,000	3,000	2,000	2,640	2,500	2,000	10,550	30,625
Citrus	130	--	--	500	120	500	40	5,800	935	3,960	500	3,050	160	4,000	3,300	22,995
Plums	295	250	105	300	310	--	75	625	650	785	500	370	600	250	2,320	7,435
Nectarines	--	--	175	450	285	500	25	715	715	850	200	565	800	20	1,000	6,300
Almonds	165	--	825	260	200	--	235	405	200	380	500	1,100	700	1,000	6,350	12,320
Walnuts	85	--	80	70	290	500	35	40	75	460	250	640	600	200	735	4,060
Olives	225	—	—	20	--	--	--	75	--	85	--	70	--	30	80	585
Other Fruit Trees	100	135	135	100	100	500	100	135	100	135	500	150	135	500	135	2,960
Sub Total	6,920	12,905	23,780	9,965	16,625	22,000	15,160	14,225	12,975	22,255	9,450	14,845	31,240	12,495	78,170	303,010
Grand Total	8,440	14,850	86,500	13,360	19,155	49,515	30,690	17,335	15,365	28,110	29,670	28,715	48,820	20,015	117,250	527,790

Table VI-6

FRESNO REGION PROJECTED AGRICULTURAL CROP ACREAGES BY ZONES FOR 2000

	ZONE															
Crop	Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	Foothill	FCMA	Region
Barley, Oats	--	--	730	110	160	375	2,000	--	200	250	480	3,000	130	1,600	12,600	21,835
Cantaloupes	125	--	12,010	145	370	450	2,800	525	30	500	3,000	500	5,500	500	890	27,345
Sugar Beets	--	--	25,600	--	50	3,850	500	--	--	500	4,000	500	700	1,000	835	37,335
Cotton	85	1,200	24,000	1,000	730	21,300	5,000	620	190	1,500	6,000	4,000	5,000	500	18,300	89,425
Tomatoes	225	--	340	290	420	1,000	2,200	580	760	2,500	9,000	3,000	3,200	1,500	2,360	27,375
Seed Alfalfa	680	745	3,400	680	680	5,000	680	745	680	2,000	1,000	4,000	--	3,000	--	23,290
Sorghum	15	--	1,200	100	25	2,000	40	130	80	200	500	800	300	500	2,710	8,600
Corn	350	--	350	1,000	85	1,000	2,000	210	220	300	2,000	500	2,000	500	625	11,140
Onions	--	--	—	--	--	250	60	--	—	50	250	50	100	500	200	1,460
Wheat	--	--	—	--	—	5	--	--	—	--	--	10	--	--	110	125
Lettuce	--	--	400	50	--	500	50	300	200	750	500	1,000	250	1,000	200	5,200
Other Vegetables	40	--	850	20	10	500	200	--	30	250	500	1,250	400	750	250	5,050
Sub Total	1,520	1,945	68,880	3,395	2,530	36,230	15,530	3,110	2,390	8,800	27,230	18,610	17,580	11,350	39,080	257,250
Grapes	4,890	12,500	23,200	6,865	14,500	21,000	13,500	5,150	8,145	15,000	4,680	6,370	25,145	4,500	42,200	207,645
Figs	—	15	--	—	--	—	--	--	--	—	--	1,100	--	435	11,500	13,050
Peaches	820	5	520	1,400	820	1,000	1,150	1,280	2,000	5,000	2,750	3,000	2,500	2,500	10,550	35,295
Citrus	130	--	--	500	120	--	40	5,800	935	5,000	1,000	4,300	160	4,500	3,300	25,485
Plums	295	250	125	300	310	650	75	625	650	1,000	1,000	500	600	300	2,320	9,000
Nectarines	--	--	195	450	285	200	25	715	715	1,000	500	1,000	800	50	1,000	6,935
Almonds	165	--	990	260	200	200	235	405	200	750	1,000	2,000	700	1,200	6,350	14,655
Walnuts	85	--	100	70	290	200	35	40	75	800	500	1,000	600	300	735	4,830
Olives	225	--	--	20	--	--	--	75	--	75	--	200	--	100	80	775
Other Fruit Trees	100	135	165	100	100	500	100	135	100	500	1,000	500	135	500	135	4,205
Sub Total	6,710	12,905	25,295	9,965	16,625	23,750	15,160	14,225	12,820	29,125	12,430	19,670	30,640	14,385	78,170	321,875
Grand Total	8,230	14,850	94,175	13,360	19,155	59,980	30,690	17,335	15,210	37,925	39,660	38,280	48,220	25,735	117,250	579,125

Table VI-7

FRESNO REGION ZONAL LAND USE PROJECTIONS (IN ACRES)

	Biola (16,600 Acres)				Caruthers (102,500 Acres)				Del Rey (14,000 Acres)				Fowler (21,400 Acres)			
	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000
Residential	180	180	190	200	455	455	455	455	594	594	594	594	568	585	650	820
Industrial	16	19	21	23	16	19	21	23	16	19	21	23	5	7	10	13
Commercial	11	14	16	18	11	14	16	18	11	14	16	18	40	63	85	115
Agricultural	11,270	13,500	14,850	14,850	51,620	73,070	86,500	94,180	9,860	13,360	13,360	13,360	16,150	20,155	19,155	19,155

	Kerman (81,500 Acres)				Kingsburg (9,700 Acres)				Laton (31,800 Acres)				Orange Cove (19,600 Acres)			
	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000
Residential	830	1,440	2,000	3,000	625	920	1,080	1,280	520	540	550	566	632	900	1,180	1,520
Industrial	23	52	90	145	34	49	62	80	16	19	21	23	29	43	56	68
Commercial	23	54	98	176	45	65	83	106	11	11	14	16	18	29	44	82
Agricultural	26,380	39,300	49,520	59,980	6,425	8,440	8,440	8,230	11,170	30,690	30,690	30,690	10,560	14,715	17,330	17,340

	Parlier (16,400 Acres)				Reedley (44,700 Acres)				Riverdale (42,100 Acres)				Sanger (42,400 Acres)			
	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000
Residential	372	560	780	1,080	1,280	1,800	2,340	3,000	647	900	1,320	1,920	1,820	2,480	2,900	3,700
Industrial	14	25	35	47	60	94	127	147	41	105	200	370	80	120	155	190
Commercial	14	26	38	57	40	62	84	114	16	42	79	148	80	124	169	230
Agricultural	11,520	15,360	15,360	15,210	17,340	24,580	28,110	37,920	8,390	18,010	29,670	39,660	22,990	23,080	28,720	38,280

	Selma 51,500				Foothill (66,700 Acres)				F.C.M.A. (209,300 Acres)				Study Area (770,200 Acres)			
	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000	1967	1980	1990	2000
Residential	1,360	1,840	2,260	2,640					34,000	40,000	54,500	72,500	43,883	53,194	70,799	93,275
Industrial	160	240	315	415					4,000	5,500	7,000	8,500	4,510	6,311	8,134	10,067
Commercial	50	75	98	130					3,380	4,550	5,500	6,500	3,761	5,161	6,358	7,730
Agricultural	36,250	48,560	48,820	48,220	6,720	9,800	20,010	25,740	82,400	108,400	117,250	121,800	329,045	461,020	527,785	584,615

Note: Agricultural Acreage Shown is for Major Crops Only.

fed mainly on grain stubble and alfalfa pastures. Due to the abundance of this source of feed, it is expected that sheep raising will continue to grow in the county. However, the hog raising industry may decline in Fresno unless some modifications are introduced to offset the increasing grain costs. Hog raising presently uses 25 to 30 acres in the region while no definite acreage can be alloted to sheep due to the migratory nature of that operation.

Dairying is a widespread operation in California and the population explosion in the metropolitan areas of the state is forcing the dairies in those areas to relocate, many of them in the San Joaquin Valley. It is projected that Fresno County may gain 10,000 to 15,000 cows in addition to the present 24,000 head of dairy cows within the next 10 years.

The poultry industry is a large-scale operation in the county with a 1966 production of 2,772,000 turkeys, 24,725,000 chicks, and 6,267,000 broilers and fryers. Due to a favorable land and climate situation and availability of adequate water, Fresno County is in a preferred position for attracting additional poultry industry. At present, about 200 acres in the study region are used for the poultry operation.

2. Residential, Industrial, and Commercial

The growth of population in each of the study region zones is accompanied by spreading of the population centers and the conversion of adjacent property from previous uses (mostly agricultural) to that of housing, industrial, and commercial uses. Table VI-7 indicates the present and projected acreage subject to residential, industrial, and commercial development for the years 1967, 1980, 1990, and 2000 in each zone of the study region.

a. Fresno-Clovis Metropolitan Area (F.C.M.A.)

The Fresno-Clovis metropolitan complex is the largest urbanized area in the county and consists of the cities and communities of Fresno, Clovis, Pinedale, Herndon, Highway City, Malaga, Calwa, Friant, and Easton. The present F.C.M.A. population of 301,000 is expected to increase to 845,000 by the year 2000.

The Fresno-Clovis Metropolitan Area has experienced a rapid increase in residential land use during the period since World War II. This growth is manifested by the 357 percent increase in the number of housing units during the period 1937-1962. This represents an increase of 61, 515 housing units by the year 1962 over the 17, 235 units for the year 1937. The estimated number of housing units for the Fresno-Clovis Metropolitan Area amounted to 94, 121 units in 1966. The bulk of this urban growth has occurred in and around the cities of Fresno and Clovis with minor growth occurring in other outlying communities in the metropolitan area.

The 1966 and 1985 distribution of housing and density of development for various parts of the F.C.M.A. is delineated in Tables VI-8 and VI-9; the total projected housing requirements for the urbanized area is shown in Table VI-10.

b. Balance of Study Region

The major residential, industrial, and commercial land usage in the other zones (i.e., other than the F.C.M.A.) are all presently clustered around the communities from which the zone names have been derived. No change is expected in this pattern during the study period to the year 2000. The growth of the zone communities will be accomplished by the conversion of surrounding vacant or agricultural land to urban usages. It should be noted that Table VI-7, indicating the present and projected urban land usage area, shows no figures for the foothill zone because urban development in that area is expected to be of a minor nature during the study period.

F. WASTE LOADINGS

1. Existing Wastes

At present, the solid wastes in the Fresno Region consists of 432, 000 tons per year of municipal wastes (residential and commercial), 256, 000 tons per year of industrial wastes, 1, 012, 000 tons per year of animal wastes and manures, and 777, 000 tons of crop residue wastes; a total of

Table VI-8

APPROXIMATE 1966 GROSS RESIDENTIAL DENSITIES IN THE FRESNO-CLOVIS METROPOLITAN AREA

Residential Statistical Area	Urbanizing Area		
	Housing Units	Acres Occupied	Housing Density Housing Units/Acre
Bullard	5,800	3,800	1.53
College	11,200	4,800	2.33
Clovis	4,000	2,000	2.00
C. B. D.	1,300	500	2.60
Eastern	320	320	1.00
Fairgrounds	15,600	5,000	3.3
Forkner	75	50	1.50
Ft. Washington	—	—	—
Highway City	400	330	1.20
Malaga	240	90	2.67
McKinley	11,310	3,600	3.08
North Fresno	18,000	5,180	3.47
Roeding	1,060	860	1.23
Sunnyside	2,100	2,400	.89
Southwest	5,000	2,400	2.1
Temperance	—	—	—
Total	76,405	31,330	
Remainder	17,716	2,670	
Metro Total	94,121	34,000	

Table VI-9

PROJECTED 1985 HOUSING DENSITY AND DISTRIBUTION

Residential Statistical Area	Urbanizing Area Housing Units	 Acres Occupied	Housing Density Housing Units/Acre
Bullard	15,900	7,950	2.00
College	17,600	7,050	2.50
Clovis	15,400	7,335	2.10
C.B.D.	1,500		
Easton	2,200	1,440	1.50
Fairgrounds	19,800	6,175	3.20
Forkner	10,100	4,815	2.10
Ft. Washington	12,100	5,250	2.30
Highway City	1,800	930	1.90
Malaga	400	155	2.60
McKinley	12,600	3,600	3.50
North Fresno	19,000	5,280	3.60
Roeding	4,300	3,625	1.20
Southwest	19,300	6,895	2.80
Sunnyside	12,900	9,920	1.30
Temperance	5,900	3,480	1.70
Total	170,800	73,900	2.30

Table VI-10

PROJECTED HOUSING REQUIREMENTS
FRESNO URBANIZED AREA

	1970	1975	1980	1985	1990	2000
Total Households	95,000	115,000	138,000	163,000	190,000	245,000
Primary Families	78,000	94,000	113,000	133,000	155,000	200,000
Primary Individuals	17,000	21,000	25,000	30,000	35,000	45,000
Single Family Units	81,500	97,400	115,500	134,800	153,000	194,000
Occupied	78,800	94,300	111,800	130,400	147,800	186,800
Vacant	2,700	3,100	3,700	4,400	5,200	7,200
Multiple Family Units	16,900	21,700	27,600	34,400	43,000	66,000
Occupied	15,200	19,500	24,800	31,000	38,700	59,400
Vacant	1,700	2,200	2,800	3,400	4,300	6,600
Mobile Homes (Occupied)	1,000	1,200	1,400	1,600	1,800	2,200
Total Occupied	95,000	115,000	138,000	163,000	188,300	248,400
Total Vacant	4,400	5,300	6,500	7,800	9,500	13,800
Total Housing Units	99,400	120,300	144,500	170,800	197,800	262,200

2,477,000 tons per year. Table VI-11 provides a breakdown of the existing municipal solid waste loadings in each zone and regional totals. Table VI-12 lists the quantities of the various industrial wastes presently being produced in each zone. The wastes in Table VI-12 are identified not only by name but by Standard Industrial Code numbers referring to the industry producing the waste, as well as the waste type number used to identify the waste in the computer program developed for this study. Tables VI-13 and VI-14 delineate the wastes in each zone associated with livestock and major crop residues, respectively, as well as regional totals for each waste.

The dimensions of the solid waste problem can more easily be envisioned when it is realized that in the Fresno Study Region, with a population of 396,000, almost 2-1/2 million tons of solid waste is being generated each year, or 6-1/4 tons per capita per year. The annual per capita generation for each type of waste is 1.10 tons of municipal waste, 0.65 tons of industrial waste, 2.55 tons of animal wastes and manures, and 1.95 tons of crop residues.

2. Projected Wastes

As the Fresno Region population increases with the accompanying commercial, industrial, and agricultural growth, the solid wastes produced in the region will increase correspondingly. Thus, by the year 2000, when the region's population is expected to exceed one million, the rate of solid waste production is expected to increase from its present estimated 2,477,000 tons per year to approximately 5,582,000 tons per year.

Table VI-15 indicates the expected municipal solid wastes generation rates in each zone for the years 1980, 1990, and 2000. The projections for ashes are not shown in the table since this item would be a function of the future waste management system. Tables VI-16, 17, and 18 are projections of industrial solid waste production in the various zones as well as regional totals for the years 1980, 1990, and 2000, respectively. Table VI-19 shows the expected animal and manure wastes, and Tables VI-20, 21, and 22 delineate the expected agricultural major crop wastes by crop and zone for the years 1980, 1990, and 2000, respectively, as well as zonal and regional totals.

Table VI-11

MUNICIPAL SOLID WASTES - 1967 - FRESNO REGION (TONS/YEAR)

Wastes	Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton	Orange Cove
Garbage	416	210	653	223	560	731	223	392
Residential Rubbish	1,060	549	1,680	574	1,190	1,880	568	1,002
Mixed Garbage	1,720	588	1,470	695	1,530	2,250	731	1,740
Street Refuse	209	44	58	62	146	199	68	219
Dead Animals	3	10	4	1	3	5	1	3
Demolition	261	54	70	78	182	248	87	280
Construction	26	5	7	8	18	25	9	28
Special Wastes	1	--	--	--	--	--	--	--
Sewage Residue	104	--	--	19	54	68	32	97
Human Fecal Matter	53	89	240	61	89	171	80	32
Ashes	155	12	24	18	37	133	59	117
Total	4,008	1,561	4,206	1,739	3,809	5,710	1,858	3,910

Wastes	Parlier	Reedley	Riverdale	Sanger	Selma	Foothill	FCMA	Region
Garbage	570	1,130	360	1,302	1,410	57	24,400	32,637
Residential Rubbish	1,440	3,220	928	3,730	3,920	142	94,800	116,683
Mixed Garbage	1,530	5,440	1,120	6,520	5,820	104	211,000	242,258
Street Refuse	118	495	102	606	495	--	1,810	4,631
Dead Animals	3	7	2	7	8	--	16	73
Demolition	147	617	129	760	594	--	2,260	5,767
Construction	15	61	13	75	61	--	228	579
Special Wastes	--	1	--	1	2	--	29	34
Sewage Residue	41	172	39	194	210	--	4,430	5,460
Human Fecal Matter	136	174	77	143	247	23	1,947	3,562
Ashes	--	598	76	204	236	3	18,368	20,040
Total	4,000	11,915	2,846	13,542	13,003	329	359,288	431,724

Table VI-12

1967 INDUSTRIAL SOLID WASTE LOADING FOR FRESNO REGION BY ZONE
(TONS PER YEAR)

Std. Industrial Code	Nature of Wastes	Type No	ZONE Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton & Foot-hill	Orange Cove	Parlier	Reedley	River-dale	Sanger	Selma	FCMA	Region
0712 0715, 2099	Cotton Trash	86	300		1,100			1,400		300			300	300	900	2,350	6,950
2034, 5048 2033, 2042 2037 Raisin 2051 Packing	Fruit and Vegetables	87	3,090	130		3,670	1,500	2,000		3,000	4,700	15,915	50	28,980	17,445	37,320	117,800
0723, 2015	Poultry	88	80			140							120			1,100	1,440
2011, 2013	Animal	89						500							900	3,465	4,865
2020	Milk Solids	90														234	234
2084	Wine & Spirits	91	4,000				4,500	100			2,000	14,000		6,500		43,000	74,100
2096, 2091	Vegetable Oils	92	400									200				2,200	2,800
2094	Tallow	93															None
2272, 2391 2328, 2512 2339, 2394	Cotton Wool and Silk	94										50				95	145
2421, 2441 2429, 2445 2431, 2511 5098	Lumber and Wood Products	95														210	210
2872	Chemicals	96			100								25			200	325
2911	Petroleum	97														10	10
3097	Plastics	98														100	100
3251, 3269 3271, 3272 3273	Masonry	99												50	150	335	535
2522, 3443 2541, 3444 3321, 3522 3351, 3551 3441, 3581 2086, 5083	Metals	100	43							27		200		420	238	2,434	3,362
5099	Seeds	101						20								110	130
Totals			7,913	130	1,200	3,810	6,000	4,020	0	3,327	6,700	30,365	495	36,250	19,633	93,163	213,006

Table VI-13

FRESNO REGION 1967 LIVESTOCK SOLID WASTE LOADINGS BY ZONES (TONS/YEAR)

Item	Kings-burg	Biola	Caru-thers	Del Rey	Fowler	Kerman	Laton	Orange Cove
Feedlots			1,725	2,300		231,100		
Dairy Farms			44,732			17,012	59,950	1,501
Poultry Farms	1,406	250	52,573	876	1,219	27,555	2,632	7,068
Sheep Farms	4,500	5,100	21,450	4,650	9,030	16,800	4,400	2,745
Hog Farms							10,890	
Total	5,906	5,350	120,480	7,826	10,249	292,467	77,872	11,314

Item	Parlier	Reedley	River-dale	Sanger	Selma	Foot-hill	FCMA	Region
Feedlots		15,809			22,995		53,400	327,329
Dairy Farms	560	8,614	24,397	4,254	22,061		76,157	259,238
Poultry Farms	1,400	6,391	4,888	2,589	17,269	8,466	41,785	176,367
Sheep Farms	14,000	14,740	9,320	15,340	27,600	2,130	78,250	230,055
Hog Farms		6,680					1,540	19,110
Total	15,960	52,234	38,605	22,183	89,925	10,599	251,132	1,012,099

Table VI-14

FRESNO REGION ZONAL AGRICULTURAL CROP WASTES - 1967 (TONS/YEAR)

Crop	Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	Foothill	FCMA	Region
Barley, Oats	--	--	1,752	17	286	729	327	--	30	511	9,312	6,055	659	3,150	21,576	44,404
Cantaloupes	293	--	23,843	44	1,165	924	8,430	1,200	75	676	5,850	344	13,136	521	2,031	58,532
Sugar Beets	--	--	33,983	--	107	4,963	984	--	--	--	4,348	--	1,147	--	948	46,480
Cotton	100	1,120	19,699	148	822	17,506	6,672	590	210	903	4,626	2,478	5,504	346	17,407	78,131
Tomatoes	131	--	1,522	157	221	211	1,410	275	402	939	3,638	937	1,681	617	1,132	13,273
Seed Alfalfa	375	375	1,500	375	375	750	375	375	375	750	--	1,500	--	--	375	7,500
Sorghum	30	--	1,850	132	37	1,608	80	225	128	263	530	587	545	521	4,647	11,183
Corn	690	--	463	180	166	365	4,380	310	428	313	1,826	72	3,329	107	956	13,585
Onions	--	--	--	--	--	--	68	--	--	--	17	--	--	--	--	85
Wheat	--	--	--	--	--	4	--	--	--	--	--	16	--	20	140	180
Lettuce	--	--	--	--	--	--	--	--	--	65	--	165	50	103	69	452
Other Vegetables	13	--	297	24	12	--	324	250	37	250	323	162	384	--	23	2,099
Sub Total	1,632	1,495	84,909	1,077	3,191	27,060	23,050	3,225	1,685	4,670	30,470	12,316	26,435	5,385	49,304	275,904
Grapes	11,157	27,000	43,901	16,206	31,913	33,790	3,025	10,280	19,010	24,744	145	24,961	59,665	3,766	84,565	394,128
Figs	--	39	--	--	--	6	--	--	--	--	--	3,122	--	1,257	29,490	33,914
Peaches	1,328	44	598	2,716	2,781	31	1,714	1,704	3,566	3,934	43	3,471	3,579	705	13,847	40,061
Citrus	90	--	--	409	83	--	30	3,415	666	2,179	--	1,757	100	1,663	1,881	12,273
Plums	318	193	92	419	336	47	82	545	700	682	--	322	595	23	2,044	6,398
Nectarines	567	--	166	869	417	--	40	797	1,036	932	--	606	1,031	19	1,094	7,574
Almonds	51	--	210	164	61	--	77	123	98	94	65	261	213	32	1,678	3,127
Walnuts	49	--	37	431	173	--	20	19	44	223	--	312	336	23	359	2,026
Olives	--	--	--	26	1	--	--	110	3	124	--	111	1	60	120	556
Other Fruit Trees	--	--	--	--	--	--	562	--	--	--	110	--	110	--	22	804
Sub Total	13,560	27,276	45,004	21,240	35,765	33,874	5,550	16,993	25,123	32,912	363	34,923	65,630	7,548	135,100	500,861
Grand Total	15,192	28,771	129,913	22,317	38,956	60,934	28,600	20,218	26,808	37,582	30,833	47,239	92,065	12,933	184,404	776,765

Table VI-15

FRESNO REGION PROJECTED MUNICIPAL SOLID WASTES (TONS/YEAR)

1980

WASTES	KINGSBURG	BIOLA	CARUTHERS	DEL REY	FOWLER	KERMAN	LATON	ORANGE COVE	PARLIER	REEDLEY	RIVERDALE	SANGER	SELMA	FOOTHILL	FCMA	REGION
Garbage	660	270	910	299	678	1,260	295	625	825	1,705	720	2,030	2,110	70	42,500	54,947
Residential Rubbish	1,710	705	2,350	745	1,755	3,260	755	1,620	2,125	4,880	1,860	5,865	5,910	180	152,600	186,320
Mixed Garbage	2,820	760	2,025	915	2,360	4,410	970	2,860	2,510	8,575	2,455	10,590	8,965	130	358,000	408,345
Street Refuse	320	50	64	71	208	390	60	320	185	705	215	890	660	4	2,710	6,872
Dead Animals	3	10	5	2	3	6	2	3	4	9	4	10	11	-	23	95
Demolition	378	60	80	90	260	485	100	400	230	885	265	1,115	825	4	3,390	8,567
Construction	38	6	8	9	26	48	10	40	23	68	27	110	85	-	340	858
Special Wastes	1	-	-	-	-	1	-	1	1	1	1	2	2	-	40	50
Sewage Residue	160	-	41	23	76	108	40	146	54	243	74	351	295	-	7,290	8,901
Human Fecal Matter	18	65	171	49	98	210	35	23	151	198	103	182	251	19	3,800	5,373
Totals	6,108	1,926	5,654	2,193	5,464	10,178	2,287	6,038	6,108	17,289	5,724	21,145	19,114	407	570,693	660,328

1990

WASTES	KINGSBURG	BIOLA	CARUTHERS	DEL REY	FOWLER	KERMAN	LATON	ORANGE COVE	PARLIER	REEDLEY	RIVERDALE	SANGER	SELMA	FOOTHILL	FCMA	REGION
Garbage	935	340	1,210	360	955	2,090	375	920	1,175	2,410	1,315	2,955	2,970	80	63,600	81,690
Residential Rubbish	2,380	860	3,075	925	2,430	5,910	965	2,710	2,990	6,930	3,345	8,530	8,255	205	230,000	279,510
Mixed Garbage	4,020	945	2,615	1,148	3,445	9,420	1,220	5,120	3,790	11,985	4,795	15,075	12,320	150	540,000	616,048
Street Refuse	385	55	70	80	282	705	90	435	275	950	400	1,220	865	4	3,700	9,516
Dead Animals	4	11	5	2	4	10	2	4	5	1	6	13	13	-	31	111
Demolition	485	68	88	100	350	880	110	545	345	1,190	500	1,525	1,080	4	4,630	11,900
Construction	48	7	9	10	35	88	11	55	35	120	50	150	110	-	460	1,168
Special Wastes	1	-	1	-	1	2	-	1	1	2	1	2	2	-	53	67
Sewage Residue	211	41	57	32	105	173	49	197	81	392	134	527	410	-	11,650	14,059
Human Fecal Matter	8	26	151	36	80	219	27	18	129	129	112	128	201	17	3,250	4,531
Totals	8,477	2,353	7,281	2,693	7,687	19,497	2,849	10,005	8,826	24,109	10,658	30,125	26,226	460	857,374	1,018,620

2000

WASTES	KINGSBURG	BIOLA	CARUTHERS	DEL REY	FOWLER	KERMAN	LATON	ORANGE COVE	PARLIER	REEDLEY	RIVERDALE	SANGER	SELMA	FOOTHILL	FCMA	REGION
Garbage	1,230	410	1,540	440	1,305	3,550	465	1,320	1,720	3,375	2,370	4,220	4,050	96	95,000	121,091
Residential Rubbish	3,575	1,035	3,950	1,130	3,335	10,200	1,195	3,900	4,400	9,760	6,100	12,270	11,375	240	344,000	416,465
Mixed Garbage	6,900	1,155	3,355	1,425	4,980	18,620	1,530	6,050	5,955	18,335	9,410	23,535	18,170	170	812,000	933,590
Street Refuse	495	60	77	91	362	1,270	100	600	415	1,265	750	1,665	1,135	5	5,070	13,400
Dead Animals	5	12	6	2	5	14	2	6	7	13	10	17	17	-	43	159
Demolition	615	76	96	113	480	1,600	125	745	515	1,600	935	2,080	1,420	5	6,340	16,745
Construction	61	8	10	11	48	160	12	75	52	160	95	210	140	-	635	1,677
Special Wastes	1	-	1	-	1	3	-	1	1	2	2	3	3	-	72	90
Sewage Residue	263	49	74	41	148	310	54	275	121	540	267	730	568	-	20,200	23,640
Human Fecal Matter	5	17	113	24	58	207	20	9	101	93	102	93	142	13	1,120	2,117
Totals	13,150	2,822	9,222	3,277	10,742	35,934	3,503	14,961	13,287	35,163	20,041	44,823	37,020	529	1,284,480	1,528,974

* Projection of ashes is not shown since this item is a function of the proposed system. If incineration is included in the proposed system 15% of the total load burned will be assumed as ashes.

Table VI-16

1980 INDUSTRIAL SOLID WASTE LOADING PROJECTIONS FOR FRESNO REGION BY ZONE (TONS/YEAR)

Std. Industrial Code	Nature of Wastes	Type No	ZONE Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton & Foothill	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	FCMA	Region
0712 0715, 2099	Cotton Trash	86	365		1,114			1,484		369			346	493	1,044	7,850	13,065
2034, 5048 2033, 2042 2037, Raisin 2051, Packing	Fruit and Vegetables	87	3,630	820		3,800	1,875	2,700		3,525	5,030	17,180	435	30,550	18,610	82,200	170,355
0723, 2015	Poultry	88	95			145							130			2,310	2,680
2011, 2013	Animal	89						540							970	6,090	7,600
2020	Milk Solids	90														370	370
2084	Wine & Spirits	91	4,390				4,770	605			2,290	14,920		7,660		75,860	110,495
2096, 2091	Vegetable Oils	92	415									235				3,430	4,080
2094	Tallow	93															—
2272, 2391 2328, 2512 2339, 2394	Cotton Wool and Silk	94										55				165	220
2421, 2441 2429, 2445 2431, 5098 2511	Lumber and Wood Products	95														325	325
2872	Chemicals	96			100								25			310	435
2911	Petroleum	97														20	20
3097	Plastics	98														125	125
3251, 3269 3271, 3272 3273	Masonry	99												55	160	600	815
2522, 3443 2541, 3444 3321, 3522 3351, 3551 3441, 3561 2066, 5063	Metals	100	85							70		300		540	330	5,915	7,240
5099	Seeds	101						20								200	220
Totals			8,980	820	1,214	3,945	6,645	5,349	0	3,964	7,320	32,690	936	39,298	11,114	185,770	318,045

Table VI-17

1990 INDUSTRIAL SOLID WASTE LOADING PROJECTIONS FOR FRESNO REGION BY ZONE (TONS/YEAR)

Std. Industrial Code	Nature of Wastes	Type No	ZONE														
			Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton & Foothill	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	FCMA	Region
0712 0715, 2099	Cotton Trash	86	375		1,120			1,550		415			385	620	1,135	11,500	17,100
2034, 5048 2033, 2042 2037, Raisin 2051, Packing	Fruit and Vegetables	87	4,265	920		3,930	2,335	3,860		4,240	5,480	18,750	1,100	32,620	20,050	141,200	238,750
0723, 2015	Poultry	88	105			150							145			3,270	3,670
2011, 2013	Animal	89						620							1,070	10,210	11,900
2020	Milk Solids	90														500	500
2084	Wine & Spirits	91	4,500				4,930	1,000			2,450	15,450		8,330		95,760	132,420
2096, 2091	Vegetable Oils	92	430									270				4,670	5,370
2094	Tallow	93															--
2272, 2391 2328, 2512 2339, 2394	Cotton Wool and Silk	94										60				230	290
2421, 2441 2429, 2445 2431, 2511 5098	Lumber and Wood Products	95														540	540
2872	Chemicals	96			100								25			360	465
2911	Petroleum	97														25	25
3097	Plastics	98														150	150
3251, 3269 3271, 3272 3273	Masonry	99												65	165	860	1,090
2522, 3443 2541, 3444 3321, 3522 3351, 3551 3441, 3581 5083, 2086	Metals	100	120							100		370		640	400	8,700	10,330
5099	Seeds	101						25								225	250
Totals			9,795	920	1,220	4,080	7,265	7,055	0	4,755	7,930	34,900	1,655	42,275	22,820	278,200	422,870

Table VI-18

2000 INDUSTRIAL SOLID WASTE LOADING PROJECTIONS FOR FRESNO REGION BY ZONE (TONS/YEAR)

Std. Industrial Code	Nature of Wastes	Type No	ZONE														
			Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton & Foothill	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	FCMA	Region
0712	Cotton Trash	86	405		1,125			1,630		450			430	725	1,200	14,620	20,585
0715, 2099 2034, 5048 2033, 2042 2037, Raisin 2051, Packing	Fruit and Vegetables	87	4,730	980		4,010	2,700	5,070		4,800	5,870	19,970	1,800	34,200	21,130	178,600	284,060
0723, 2015	Poultry	88	110			150							160			3,910	4,330
2011, 2013	Animal	89						780							1,220	16,600	18,600
2020	Milk Solids	90														700	700
2084	Wine & Spirits	91	4,700				5,080	1,500			2,610	15,960		9,000		115,560	154,410
2096, 2091	Vegetable Oils	92	445									305				6,170	6,920
2094	Tallow	93															--
2272, 2391 2328, 2512 2339, 2394	Cotton Wool and Silk	94										65				340	405
2421, 2441 2429, 2445 2431, 2511 5098	Lumber and Wood Products	95														655	655
2872	Chemicals	96			105								30			415	550
2911	Petroleum	97														30	30
3097	Plastics	98														175	175
3251, 3269 3271, 3272 3273	Masonry	99												80	170	1,230	1,480
2522, 3443 2541, 3444 3321, 3522 3351, 3551 3441, 3581 2086, 5083	Metals	100	160							150		470		770	490	12,670	14,710
5099	Seeds	101						25								255	280
Totals			10,550	980	1,230	4,160	7,780	9,005	0	5,400	8,480	36,770	2,420	44,775	24,210	352,130	507,890

Table VI-19

FRESNO REGION PROJECTED LIVESTOCK SOLID WASTE LOADING BY ZONE (TONS/YEAR)

WASTE SOURCE	KINGSBURG	BIOLA	CARUTHERS	DEL REY	FOWLER	KERMAN	LATON	ORANGE COVE	PARLIER	REEDLEY	RIVERDALE	SANGER	SELMA	FOOTHILL	FCMA	REGION
								1980								
Feedlots	1[illegible],250	11,625	49,000	10,600	20,725	38,500	10,025	6,250	31,750	33,500	21,350	35,000	63,000	4,875	178,550	525,000
Dairy Farms	8,200	9,300	39,200	8,490	16,600	30,700	8,030	5,000	25,400	26,800	17,100	27,900	50,400	3,900	142,980	420,000
Poultry Farms	[illegible],250	7,700	29,800	6,460	12,600	23,400	6,110	3,810	19,400	20,400	13,000	21,300	38,400	3,000	108,270	319,900
Sheep Farms	5,240	5,980	25,200	5,460	10,600	19,700	5,160	3,220	16,400	17,300	10,950	16,000	32,400	2,500	91,850	270,000
Hog Farms	274	210	1,405	285	550	1,025	267	167	850	895	567	932	1,680	130	4,665	14,000
TOTAL	30,25[illegible]	34,815	144,605	31,295	61,075	113,325	29,592	18,447	93,800	98,895	62,967	101,132	185,880	14,405	526,315	1,548,900
								1990								
Feedlots	12,950	14,775	67,000	13,300	26,500	50,500	13,000	7,475	40,750	42,250	33,250	45,500	86,500	6,650	152,100	612,500
Dairy Farms	9,[illegible]	11,000	50,000	9,900	19,700	37,500	9,700	5,550	30,400	31,400	24,600	33,900	64,200	4,950	112,600	455,000
Poultry Farms	8,550	9,7[illegible]	44,400	8,7[illegible]	17,500	33,300	8,600	4,930	27,000	27,900	21,900	30,100	57,000	4,400	100,170	404,300
Sheep Farms	[illegible],660	7,[illegible]	34,500	[illegible],850	13,600	26,000	6,700	3,840	21,000	21,700	17,100	23,400	44,500	3,420	78,130	315,000
Hog Farms	255	2[illegible]0	1,312	260	520	987	255	147	800	827	650	895	1,695	130	2,977	12,000
TOTAL	35,015	43,425	197,212	3[illegible],100	77,820	148,287	38,255	21,942	119,950	124,077	97,500	133,795	253,895	19,550	445,977	1,798,800
								2000								
Feedlots	15,225	17,[illegible]5	[illegible]	1[illegible],750	31,750	61,[illegible]00	16,150	8,500	4[illegible],750	50,000	[illegible]8,000	55,250	108,650	8,550	84,750	656,250
Dairy Farms	15,300	17,[illegible]	97,100	16,700	32,000	62,500	1[illegible],400	8,620	49,500	50,600	[illegible]8,600	56,100	112,000	8,700	83,980	665,[illegible]
Poultry Farms	11,200	12,900	63,900	11,700	23,600	46,000	12,000	6,340	36,400	37,200	35,700	41,100	82,500	6,380	61,880	48[illegible],700
Sheep Farms	8,350	9,470	47,100	6,600	17,400	33,900	[illegible],850	4,670	27,200	27,400	26,300	30,400	60,560	4,700	45,100	[illegible]
Hog Farms	232	2[illegible]5	1,[illegible]10	240	475	[illegible]	[illegible]	130	775	762	730	842	1,672	130	[illegible]	[illegible]
TOTAL	50,307	57,[illegible]60	285,310	52,2[illegible]0	105,225	204,[illegible]40	53,[illegible]47	28,260	1[illegible]2,625	165,962	159,330	183,692	365,382	28,460	276,960	2,179,950

Table VI-20

FRESNO REGION PROJECTED AGRICULTURAL SOLID WASTE LOADINGS BY ZONE FOR 1980 (TONS/YEAR)

	ZONE															
Crop	Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	Foothill	FCMA	Region
Barley, Oats	--	--	1,925	190	200	840	3,500	--	350	595	1,065	6,875	245	3,620	24,675	44,160
Cantaloupes	375	--	30,000	435	1,110	1,110	6,400	1,440	90	810	6,900	405	15,300	630	2,400	69,405
Sugar Beets	--	--	54,000	--	150	8,400	1,500	--	--	--	7,260	--	1,920	--	1,590	74,820
Cotton	170	2,040	35,200	2,000	1,460	31,400	15,000	1,060	380	1,620	8,260	4,460	9,620	620	30,200	136,490
Tomatoes	675	--	840	870	1,260	1,170	6,600	1,560	2,280	5,280	20,400	5,340	9,300	3,300	6,300	65,235
Seed alfalfa	510	510	2,175	510	510	2,175	510	510	510	1,050	--	2,175	--	--	--	11,145
Sorghum	45	--	2,700	300	75	2,400	120	165	240	390	810	870	810	780	6,900	16,605
Corn	1,575	--	1,035	4,500	380	855	9,000	720	990	720	4,275	150	7,875	245	2,675	35,010
Watermelon	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oats	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Onions	--	--	--	--	--	--	120	--	--	--	300	--	150	150	350	1,070
Wheat	--	--	--	--	--	5	--	--	--	--	--	20	--	25	170	220
Lettuce	--	--	800	200	--	--	200	800	800	1,340	--	1,520	900	600	540	7,700
Other Vegetables	80	--	700	40	20	--	400	--	60	70	90	230	700	--	300	2,690
Sub Total	3,430	2,550	129,375	9,045	5,245	48,355	40,390	6,255	5,700	11,875	49,360	22,055	46,880	9,970	76,100	466,550
Grapes	12,750	26,750	50,250	17,500	36,250	38,750	33,750	11,750	20,750	28,750	10	7,250	67,500	4,250	97,500	455,760
Figs	--	35	--	--	--	10	--	--	--	--	--	2,925	--	1,235	29,250	33,455
Peaches	2,050	10	975	3,500	4,550	50	2,875	2,750	5,000	6,500	75	5,750	5,875	1,155	22,625	63,750
Citrus	130	--	--	500	120	--	40	4,650	935	3,100	--	2,300	150	2,350	2,650	17,125
Plums	590	370	170	600	620	90	150	1,020	1,300	1,270	--	600	1,110	400	3,800	12,090
Nectarines	--	--	325	1,125	710	--	65	1,335	1,785	1,600	--	1,065	1,800	35	1,685	11,730
Almonds	215	--	845	340	260	--	305	495	260	390	260	1,105	845	130	6,695	12,145
Walnuts	65	--	60	70	290	--	35	35	75	375	--	520	560	40	600	2,745
Olives	280	--	--	25	--	--	--	100	--	110	--	95	--	45	105	760
Other Fruit Trees	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	3,750
Sub Total	16,350	29,415	52,875	23,910	43,050	39,150	37,470	22,385	30,355	42,345	595	22,060	78,090	9,900	165,360	613,310
Grand Total	19,780	31,965	182,250	32,955	48,295	87,505	77,820	28,640	36,055	54,220	49,955	44,115	124,970	19,870	241,460	1,079,860

Table VI-21

FRESNO REGION PROJECTED AGRICULTURAL SOLID WASTE LOADINGS BY ZONES FOR 1990 (TONS/YEAR)

	ZONE														
Crop	Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	Foothill	FCMA	Region
Barley, Oats	--	--	1,750	195	280	760	3,500	--	350	525	960	6,230	225	3,325	22,400	40,500
Cantaloupes	375	--	33,000	435	1,110	1,500	8,400	1,575	90	885	7,650	1,500	16,500	690	2,670	76,380
Sugar Beets	--	--	66,000	--	150	9,900	1,500	--	--	--	8,700	1,500	2,100	1,500	1,905	93,255
Cotton	170	2,400	46,000	2,000	1,460	37,000	10,000	1,240	380	1,900	9,700	5,220	10,000	730	36,600	164,800
Tomatoes	675	--	960	870	1,260	1,320	6,600	1,740	2,280	5,850	22,800	6,000	9,600	3,870	7,080	70,905
Seed Alfalfa	510	560	2,360	510	510	2,360	510	560	510	1,125	--	2,360	--	1,500	--	13,375
Sorghum	45	--	3,150	300	75	2,805	120	390	240	465	930	1,020	900	915	8,130	19,485
Corn	1,575	--	1,350	4,500	380	1,125	9,000	945	990	900	5,355	200	9,000	315	2,810	38,445
Onions	--	--	--	--	--	--	120	--	--	--	400	400	200	240	400	1,760
Wheat	--	--	--	--	--	5	--	--	--	--	--	10	--	20	145	180
Lettuce	--	--	1,200	200	--	--	200	1,200	800	1,800	--	3,000	1,000	900	800	11,100
Other Vegetables	80	--	1,200	40	20	--	400	--	60	110	140	400	600	1,000	500	4,750
Sub Total	3,430	2,960	156,970	9,050	5,245	56,775	40,350	7,650	5,700	13,560	56,635	27,840	50,325	15,005	83,440	534,935
Grapes	12,750	31,250	55,000	17,500	36,250	47,500	33,750	12,875	20,750	31,500	12,500	12,500	67,500	10,000	105,500	507,125
Figs	--	35	--	--	--	2,250	--	--	--	--	--	2,835	--	1,115	25,875	32,110
Peaches	2,050	10	1,150	3,500	2,050	--	2,875	3,200	5,000	7,500	5,000	6,600	6,250	5,000	26,375	76,560
Citrus	130	--	--	500	120	500	40	5,800	935	3,960	500	3,050	160	4,000	3,300	22,995
Plums	590	500	210	600	620	--	150	1,250	1,300	1,570	1,000	740	1,200	500	4,640	14,870
Nectarines	--	--	440	1,125	710	1,250	60	1,790	1,790	2,125	500	1,410	2,000	50	2,500	15,750
Almonds	215	--	1,070	340	260	--	305	525	260	495	650	1,430	900	1,300	8,255	16,010
Walnuts	85	--	80	70	290	500	35	40	75	460	250	640	600	200	735	4,060
Olives	280	--	--	25	--	--	--	95	--	105	--	90	--	40	100	730
Other Fruit Trees	250	340	340	250	250	1,250	250	340	250	340	1,250	375	340	1,250	340	7,415
Sub Total	16,350	32,135	58,290	23,910	40,550	53,250	37,465	25,915	30,360	48,055	21,650	29,670	78,950	23,455	177,620	697,625
Grand Total	19,780	35,095	215,260	32,960	45,795	110,025	77,815	33,565	36,060	61,614	78,285	57,510	129,275	38,460	261,060	1,232,560

Table VI-22

FRESNO REGION PROJECTED AGRICULTURAL SOLID WASTE LOADINGS BY ZONES FOR 2000 (TONS/YEAR)

	ZONE														
Crop	Kingsburg	Biola	Caruthers	Del Rey	Fowler	Kerman	Laton	Orange Cove	Parlier	Reedley	Riverdale	Sanger	Selma	Foothill	FCMA	Region
Barley, Oats	--	--	1,275	190	280	655	3,500	--	350	435	840	5,250	225	2,800	22,400	38,200
Cantaloupes	375	--	36,030	435	1,110	1,350	8,400	1,575	90	1,500	9,000	1,500	16,500	1,500	2,670	82,035
Sugar Beets	--	--	76,800	--	150	11,550	1,500	--	--	1,500	12,000	1,500	2,100	3,000	1,905	112,005
Cotton	170	2,400	48,000	2,000	1,460	42,600	10,000	1,240	380	3,000	12,000	8,000	10,000	1,000	36,600	178,850
Tomatoes	675	--	1,020	870	1,260	3,000	6,600	1,740	2,280	7,500	27,000	9,000	9,600	4,500	7,080	82,125
Seed Alfalfa	510	560	2,550	510	510	3,750	510	560	510	1,500	750	3,000	--	2,250	--	17,470
Sorghum	45	--	3,600	300	75	6,000	120	390	240	600	1,500	2,400	900	1,500	8,130	25,800
Corn	1,575	--	1,575	4,500	380	4,500	9,000	945	990	1,350	9,000	2,250	9,000	2,250	2,810	50,125
Watermelon	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oats	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Onions	--	--	--	--	--	500	120	--	--	100	500	100	200	1,000	400	2,920
Wheat	--	--	--	--	--	5	--	--	--	--	--	10	--	--	140	155
Lettuce	--	--	1,600	200	--	2,000	200	1,200	800	3,000	2,000	4,000	1,000	4,000	800	20,800
Other Vegetables	80	--	1,700	40	20	1,000	400	--	60	500	1,000	2,500	800	1,500	500	10,100
Sub Total	3,430	2,960	174,150	9,045	5,245	76,910	40,350	7,650	5,700	20,985	75,590	39,510	50,325	25,300	83,435	620,585
Grapes	12,750	31,250	58,000	17,500	36,250	52,500	33,750	12,875	20,750	37,500	15,000	18,750	67,500	11,250	105,500	531,125
Figs	--	35	--	--	--	--	--	--	--	--	--	2,475	--	980	25,875	29,365
Peaches	2,050	10	1,300	3,500	2,050	2,500	2,875	3,200	5,000	12,500	6,875	7,500	6,250	6,250	26,375	88,235
Citrus	130	--	--	500	120	--	40	5,800	935	5,000	1,000	4,000	160	4,500	3,300	25,485
Plums	590	500	250	600	620	1,300	150	1,250	1,300	2,000	2,000	1,000	1,200	600	4,640	18,000
Nectarines	--	--	485	1,125	710	500	60	1,785	1,785	2,500	1,250	2,500	2,000	125	2,500	17,330
Almonds	215	--	1,285	340	260	260	305	525	260	975	1,300	2,600	910	1,560	8,255	19,050
Walnuts	85	--	100	70	290	200	35	40	75	800	500	1,000	600	300	735	4,830
Olives	280	--	--	25	--	--	--	95	--	95	--	250	--	125	100	970
Other Fruit Trees	250	335	410	250	250	1,250	250	335	250	1,250	2,500	1,250	335	1,250	335	10,500
Sub Total	16,350	32,130	61,830	23,910	40,550	58,510	37,465	25,905	30,355	62,620	30,425	41,325	78,955	26,940	177,615	744,890
Grand Total	19,780	35,090	235,980	32,955	45,795	135,420	77,815	33,555	36,055	83,605	106,015	80,835	129,280	52,240	261,050	1,365,475

G. RESTRICTIONS

1. Legislative

The political system of the U.S., based as it is on the constitutional provisions of governmental responsibilities and guarantees of individual liberties, has recognized certain functions as being definitely within the sphere of governmental activities, others which should be just as definitely in the province of private enterprise, and a middle ground or gray area between the constitutionally guaranteed individual liberties and activities that are the duty and responsibility of democratic government. Activities or functions falling in this gray area may take on aspects of both extremes, i.e., they may touch on or concern the health, safety, or welfare of the people, thus suggesting governmental control or operation, while at the same time they are intimately intertwined with guaranteed individual liberties or are particularly suited to operation by the private sector of society. Power production, water supply, and sanitation fall into this gray area.

This area has no clear guidelines as to optimal administration or control. In the field of solid waste management, dealing with many aspects of public health, it is easy to reach a conclusion that this function is entirely within the scope of governmental responsibility and the recognized police powers of the state. Waste management, however, deals as well with control of the uses to which private property may be put, with the activities of individuals on their own land, and with operations that are perhaps best performed by private enterprise.

Thus, any scheme that is optimal from the standpoint of solid waste management must seek to balance the conflicts between legitimate government concern and private enterprise, the desires for regional uniformity and the demands for local autonomy, the guaranteed freedoms of individual activity, and the permissible scope of governmental regulation and control.

a. State Legislation

State legislation, for the most part, is enabling in nature. Rather than providing for detailed substantive methods of solid waste system operation, it provides broad procedural bases for undertaking solutions to solid waste and related problems. It confers on governmental subdivisions - counties and municipalities - authority to enact legislation related to solid waste management. It further specifies a variety of administrative configurations to manage and control these activities. The choice of appropriate administrative methods and optimal operating procedures is left to the local government acting within the scope of these delegated powers. Charter cities are allowed even greater powers than those incorporated under general law.

In the area of solid waste management, most of the State legislation is found in the Health and Safety Code. Other legislation - such as the Zoning Enabling Act and the Subdivision Map Act - is also pertinent. Sections 850, 4100, 4200 through 4204, 4250, 4260, 4700, and 6400 of the State Health and Safety Code are the basis for the control of solid waste in California.

b. County Ordinances

County ordinances for the most part are implementing in nature. Acting on the authority of enabling legislation by the State, county ordinances develop detailed methods by which waste management objectives are to be met.

Chapter 3 of the Fresno County Ordinance Code is concerned with garbage and rubbish disposal. In addition, the County Zoning Ordinance, through its control of condition-use permits, in a sense regulates the location and operation of disposal sites as well as the transport of solid waste. The following sections of the Fresno County Ordinance Code are applicable to solid waste management: Sections 450, 451, 452, 454, 455, 456, and Section 800 et. seq.

c. Municipal Legislation

Municipal legislation is for the most part directed toward detailed definition of methods and techniques for, and means of financing the collection and disposal of solid wastes. It is primarily implementing in nature, rather than enabling. The Municipal Code of the City of Fresno exemplifies this type of legislation. The group of ordinances in that code pertaining to solid waste disposal are contained in Article IV, entitled "Garbage, Rubbish, and Refuse" (Sections 9-401 through 9-414 of the code).

d. Resulting Practices in the Study Region

In general, the result of existing policies has produced a heterogeneous system of waste management in the Fresno region. The municipal areas, having their own individual sets of waste management ordinances, are each slightly different from the other and from the County. Practices of ultimate disposal vary with each individual dump site. The number of collection routines is virtually as large as the number of individual collectors.

The current area legislation is general and nonrestrictive in nature. The practices that have developed have done so largely because of a lack of detailed legislative commands rather than because of adherence to specific laws or ordinances. Some of the apparent difficulties are as follows:

(1) Nonstandardization

This characteristic applies both to equipment and to practices in the Fresno area. The free market orientation of the current system does not lend itself to achieving the economies of scale which could be gained through uniformity of both equipment and technique.

Insofar as equipment is concerned, uniformity of collecting, trucks, containers, etc., would obviously lead to uniformity of maintenance schedules, collection practices and schedules, personnel training, rates, and replacement costs. Operating conditions, i.e., equipment required for alleys and other problems will obviously prevent total standardization.

Standardization is, of course, not an end in itself, but only a means to the achievement of these economies.

(2) Duplication of Routes and Collection Responsibilities

The irregular boundaries of municipal and county areas give rise to situations where a city collection truck and a private collector's truck are passing each other on the same street. The duplication of routes combined with the nonstandard service given results in a further distortion of ideal free market conditions. Recently, a great step forward was taken in the direction of eliminating duplication of services in the Fresno Metropolitan zone by the combining of nine private companies into a single firm which will supply uniform services to all the area within the operating zone of the nine former companies.

(3) Noncompetition with Government

The laws and ordinances which regulate the collection and removal of solid wastes impose only the most general of restrictions as to rates upon collectors and disposers. While competition to a certain extent exists among these collectors, no government agency, apart from the municipalities which presently conduct their own collection operations, currently has the capability to undertake the operation of a collection and disposal system. The presence of such a capability would, without further legislation, operate as a control both upon rates to be charged and on collection and disposal practices.

(4) Exclusion of Alternate Methods of Disposal

Current legislation restricts ultimate disposal in the county to the sanitary landfill method. While the reasons for this restriction have a logical basis, that of preventing open burning and its contaminant air pollution problems, it none the less legally precludes the use of advanced incineration techniques, composting, etc. All these should be available for consideration, at least in the period of synthesis of any new system. It is worth noting that no attempt has been made to enforce this legislation until quite recently, since both open burning and open dumping have been practiced for many years. This exclusion does not apply to the incorporated cities.

(5) Lack of Property Right Interest Vesting in Operators

The currently used system of allowing private collectors to operate in the Fresno area (outside city limits) is based on the issuance of nonproprietary permits. Upon application for a permit and provision of the necessary information, a potential operator is issued a permit to which no property rights attach. It is revocable with reasonable notice and, barring some reason which is neither arbitrary nor unreasonable on the part of the county, permits must be issued when a properly executed application is filed.

The effect of this is two-fold. First, the operator, having no vested property right is encouraged to make as much as he can as fast as he can. He desires as low a capital investment as possible and is not as concerned with long-term steady gain as he is with rapid initial return on that investment. Second, without the vesting of property rights of some kind in the operator, the government is somewhat limited in what it may demand of the operator in terms of service to newly developed areas, types of service, equipment to be used, and the like.

(6) Lack of Firm Financial Base for Operations

With the exception of those municipalities conducting their own scavenging operations, the financial base of solid waste management operations is dependent upon the financial conditions of the individual operators.

As previously enacted, legislative authority exists for issuance of bonds, levy of taxes, etc. Under the current organizational arrangement these methods of funding are of little help to the system and to the consumer.

e. Governmental Relationships

Most of the problems pointed out in the preceding sections find their source in some aspect of organization or the lack of it. The definition of how much governmental activity and what kind of governmental activity is desirable is a prerequisite to the proposal of any organizational scheme. The correct mixture of entrepreneurial and ministerial skills must be attained if an organization is to function satisfactorily and provide adequate service within the framework of the desires of the community.

The necessary first step in this definition is the determination of the scope of governmental activity. How far can government go into the private sphere without running afoul of constitutional limitations or lack of enabling legislation? It seems clear from the great weight of authority that municipalities which are independent governmental bodies and county governments which are agencies of the State, have a duty to protect the health, safety, comfort, and general welfare of their residents. Thus, in the proper exercise of the police power, they may regulate the removal of garbage and rubbish by either taking such services upon themselves as governmental function, which may be exercised by excluding private operators from the field, or by contracting with private removal and disposal enterprises. The only major restrictions placed upon this police power are that the measures taken by the municipality or county to secure the removal of garbage and rubbish must bear reasonable relationships to the established duty of protecting public health and must not discriminate arbitrarily and capriciously in favor of one private group to the detriment of another.

This same conclusion may be reached under statutes authorizing governmental agencies to make all regulations necessary or expedient for the promotion of health and the suppression of disease.

To eliminate and reduce the present system's organizational shortcomings, a regional approach via the county could be superimposed within the existing framework of enabling legislation. There are also three types of districts that can be established under the existing laws: the Refuse Disposal District, the Sanitation District, and the Sanitary District. The organizational structure of these entities is illustrated in Figures VI-9, 10, and 11, respectively.

The use of an organizational vehicle other than the county approach and the three illustrated, or modifications to these, would require changes and/or additions to the existing legislation.

The superposition of a regional district or management authority for waste management would probably result in considerable political concern from those smaller communities which contract all waste

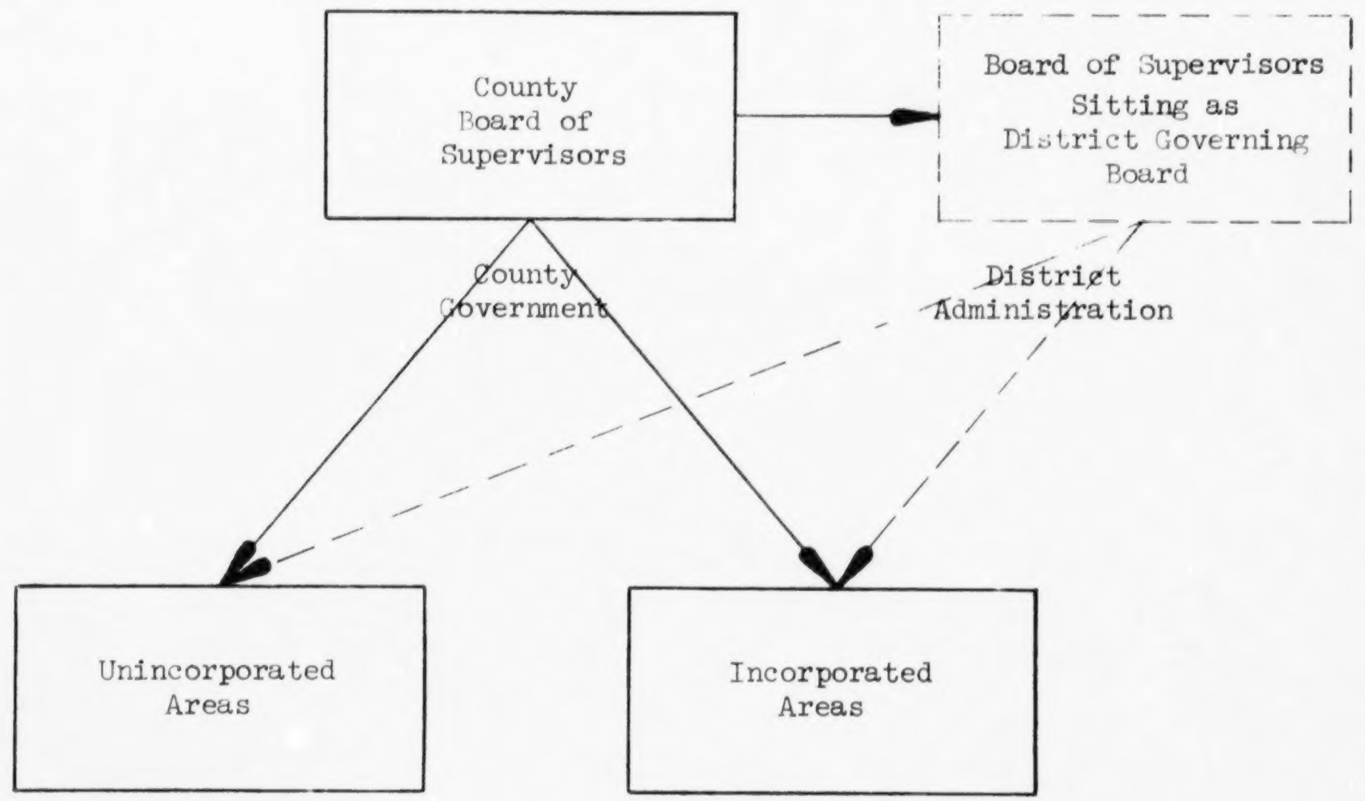

County
Board of
Supervisors
Board of Supervisors
Sitting as
District Governing
Board
County
Government
District
Administration
Unincorporated
Areas
Incorporated
Areas

Figure VI-9. Garbage and Refuse Disposal District

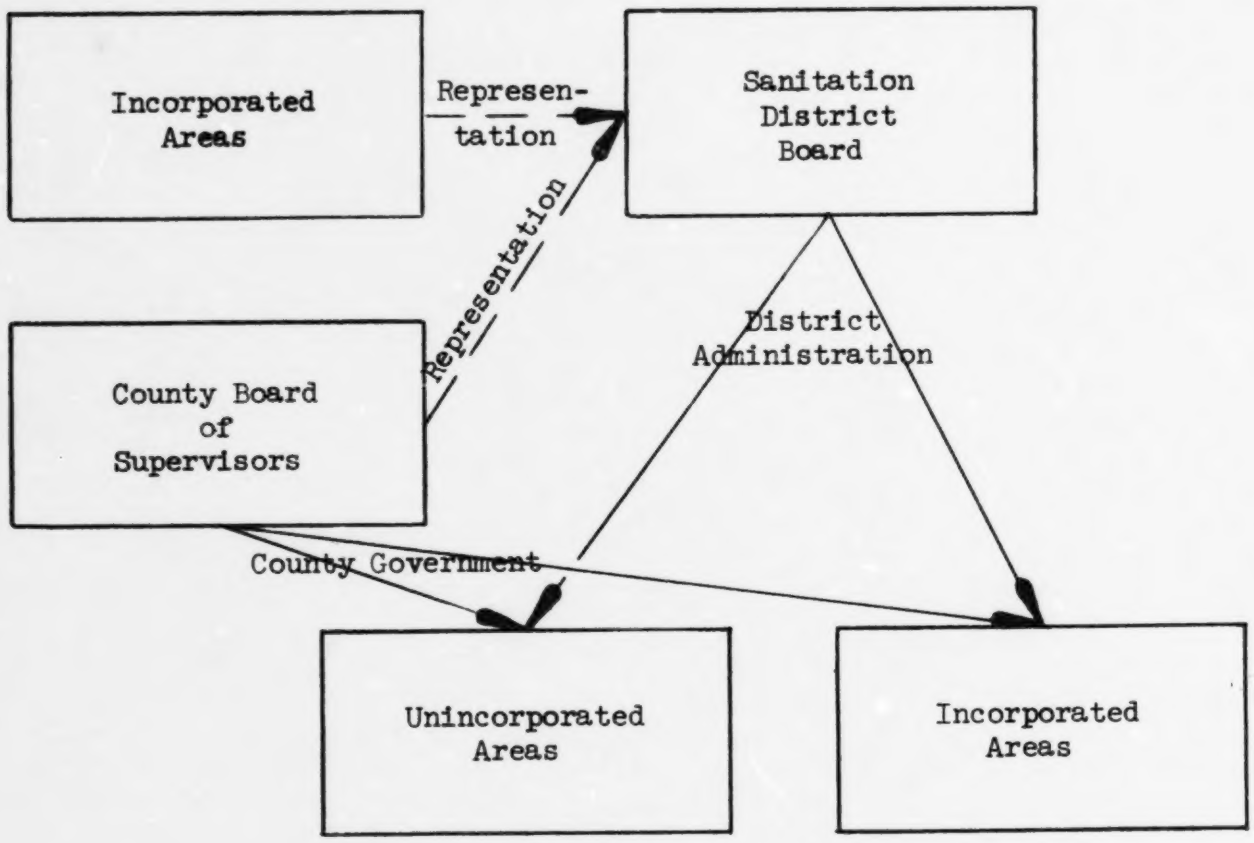

Incorporated Areas
Represen-tation
Sanitation District Board
Representation
County Board of Supervisors
District Administration
County Government
Unincorporated Areas
Incorporated Areas

Figure VI-10. Sanitation District

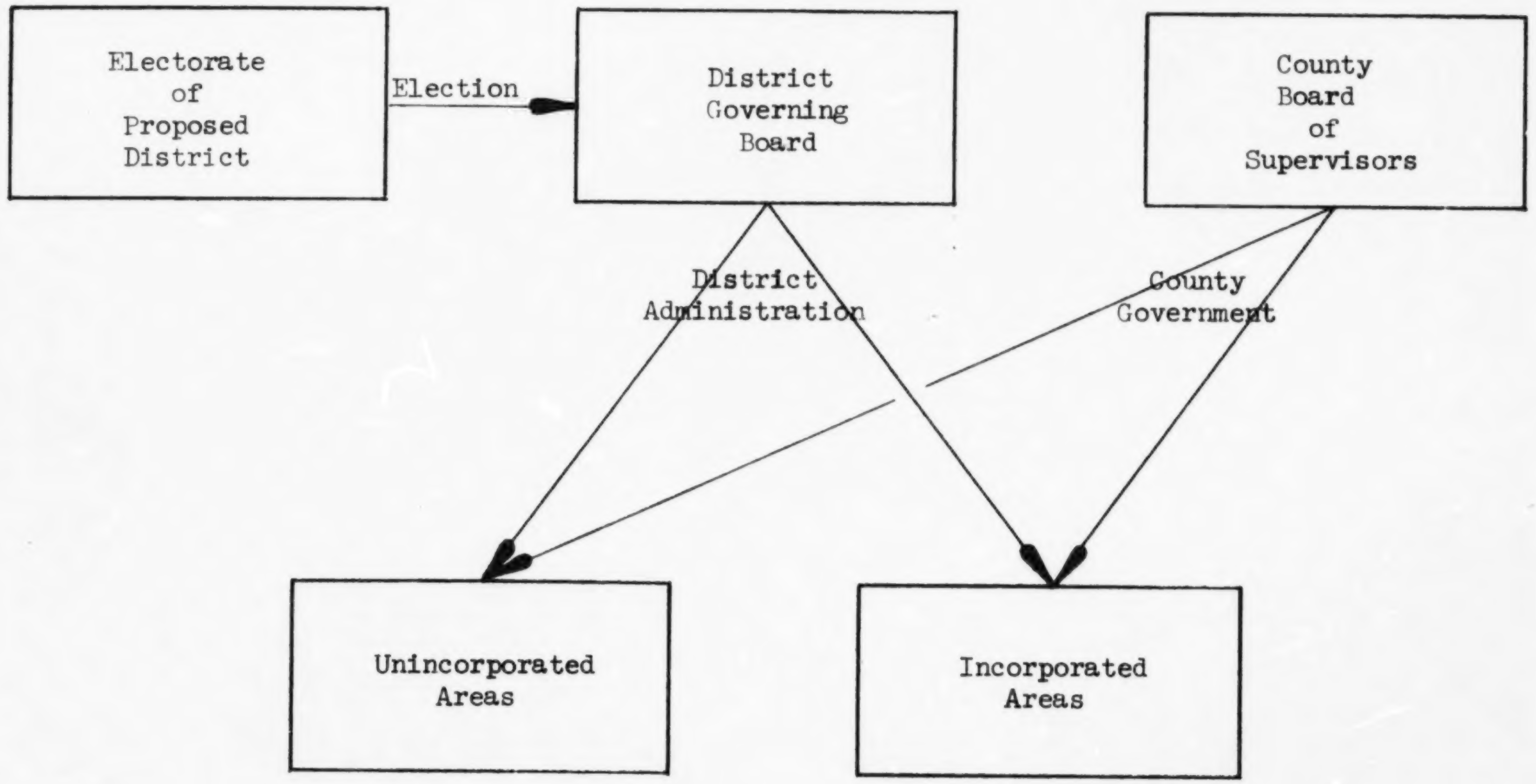

Electorate of Proposed District
Election
District Governing Board
County Board of Supervisors
District Administration
County Government
Unincorporated Areas
Incorporated Areas

Figure VI-11. Sanitary District

management service with private collectors and disposal companies. The City of Fresno, with an elaborate structure for municipal operation of a collection system could also be expected to object to the elimination of that system in favor of an overall regional scheme, but not to a regional disposal operation. The same objections may be forthcoming from the smaller cities operating municipal waste management systems. Because Fresno is a major metropolitan center and the largest municipality in the region, its position must be particularly scrutinized and whatever plan is evolved must consider the desire for autonomy on the part of municipalities.

2. State Department of Health Guidelines

At the time this report is being prepared, no definitive California State Department of Health guidelines on the handling or disposal of solid wastes have been published. A criterion of this type, however, is currently being prepared. Table VI-23 is an excerpt from the preliminary State guidelines recommending maximum source storage periods for various types of municipal, agricultural, and industrial wastes. The controlling environmental effect that determines the maximum storage times is also shown.

3. Economic Capacities and Projections

The financing of solid waste management systems in the Fresno Region has historically been on a service charge basis; that is, the revenues charged for collection of the wastes and the use of disposal sites or dumps have been the sole source of financing the service. Since World War II there has been an ever increasing trend to consider solid waste disposal as a utility service, the same as sanitary sewers and water, and the financing of such utilities have often been accomplished by the issuance of bonds and by appropriation from direct tax revenues as well as by the service charge method.

Table VI-23

MUNICIPAL WASTES

Waste	Maximum Period of Source Storage	Controlling Environmental Effect
Garbage	4 days	Flies
Residential Rubbish	7 days	Land Pollution Flies
Mixed Garbage	4 days	Flies
Street Refuse	7 days	Unsightliness
Dead Animals	1 day	Flies Animal Disease Land Pollution
Abondoned Vehicles	7 days	Unsightliness Land Pollution
Demolition Wastes	7 days	Land Pollution
Construction Wastes	7 days	Land Pollution
Special Wastes	1 day	Human Disease
Sewage Treatment Residue	7 days	Flies
Water Treatment Residue	14 days	Water Quality Air Pollution
Ashes	14 days	Air Pollution Unsightliness
Human Fecal Matter	1 day	Flies Human Disease

Table VI-23 (Continued)

AGRICULTURAL WASTES

Waste	Maximum Period of Source Storage	Controlling Environmental Effect
Barley	7 days	Plant Disease Rodents
Beans, dry	7 days	Plant Disease Rodents
Corn	7 days	Plant Diseases Rodents
Cotton Lint	7 days	Plant Disease Rodents
Cotton Seed	7 days	Plant Disease Rodents
Hay	7 days	Plant Disease Rodents
Oats	7 daysq	Plant Disease Rodents
Alfalfa	7 days	Plant Disease Rodents
Rice	7 days	Plant Disease Rodents
Safflower	7 days	Plant Disease Rodents
Sorghum	7 days	Plant Disease Rodents
Sugar Beets	7 days	Plant Disease Rodents

Table VI-23 (Continued)

AGRICULTURAL WASTES

Waste	Maximum Period of Source Storage	Controlling Environmental Effect
Wheat	7 days	Plant Disease Rodents
Beans	7 days	Plant Disease Flies
Cabbage	7 days	Plant Disease Flies
Chinese Vegetables	7 days	Plant Disease Flies
Sweet Corn	7 days	Plant Disease Flies
Cucumbers	7 days	Plant Disease Flies
Melons	7 days	Plant Disease Flies
Onions	7 days	Plant Disease Flies
Peppers	7 days	Plant Disease Flies
Radishes	7 days	Plant Disease Flies
Romaine	7 days	Plant Disease Flies
Squash	7 days	Plant Disease Flies

Table VI-23 (Continued)

AGRICULTURAL WASTES

Waste	Maximum Period of Source Storage	Controlling Environmental Effect
Sweet Potatoes	7 days	Plant Disease Flies
Tomatoes	7 days	Plant Disease Flies
Turnips	7 days	Plant Disease Flies
Almonds	7 days	Land Pollution Flies
Apricots	7 days	Land Pollution Flies
Bushberries	7 days	Land Pollution Flies
Figs	7 days	Land Pollution Flies
Grapefruit	7 days	Land Pollution Flies
Grapes	7 days	Land Pollution Flies
Lemons	7 days	Land Pollution Flies
Nectarines	7 days	Land Pollution Flies
Olives	7 days	Land Pollution Flies

Table VI-23 (Continued)

AGRICULTURAL WASTES

Waste	Maximum Period of Source Storage	Controlling Environmental Effect
Oranges	7 days	Land Pollution Flies
Peaches	7 days	Land Pollution Flies
Persimmons	7 days	Land Pollution Flies
Plums	7 days	Land Pollution Flies
Pomegranates	7 days	Land Pollution Flies
Strawberries	7 days	Land Pollution Flies
Walnuts	7 days	Land Pollution Flies
Beef Cattle	7 days	Flies
Dairy Cattle	7 days	Flies
Sheep	7 days	Animal Disease
Hogs	7 days	Flies
Horses and Mules	7 days	Flies
Chickens	7 days	Flies
Turkeys	7 days	Flies
Pigeons	7 days	Human Disease

Table VI-23 (Continued)

AGRICULTURAL WASTES

Waste	Maximum Period of Source Storage	Controlling Environmental Effect
Rabbits	7 days	Flies
Livestock Feed	7 days	Rodents Flies

INDUSTRIAL WASTES

Waste	Maximum Period of Source Storage	Controlling Environmental Effect
Cotton Trash	7 days	Land Pollution
Fruit and Vegetables	1 day	Land Pollution Rodents Flies
Poultry	1 day	Animal Disease Flies
Animal	1 day	Animal Disease Land Pollution
Milk Solids	1 day	Land Pollution
Wine and Spirits	1 day	Rodents Flies
Vegetable Oils	1 day	Land Pollution
Tallow	1 day	Animal Disease Land Pollution
Cotton, Wool, Silk	7 days	Unsightliness
Lumber and Wood Products	14 days	Rodents Unsightliness

Table VI-23 (Continued)

INDUSTRIAL WASTES

Waste	Maximum Period of Source Storage	Controlling Environmental Effect
Chemicals	7 days	Safety Hazards Toxicity
Petroleum	7 days	Safety Hazards Toxicity
Plastics	14 days	Unsightliness Rodents
Masonry Wastes	7 days	Land Pollution
Metals	14 days	Land Pollution Rodents
Seeds	7 days	Rodents Safety Hazards
Tires	14 days	Rodents Other Insects

a. Per-Capita Income

The per-capita income at present in Fresno County is approximately $2,800. This is expected to increase 118 percent to $6,100 by the year 2000. Figure VI-12 is a graph of the projected per-capita income in Fresno County to the year 2000. On the basis of per-capita income, the Fresno Region at present has a total income of 1.11 billion dollars. The projected increase in population from the present 396,000 to 1,056,000, combined with the expected increase in per-capita income in the year 2000, could result in a 6.5 billion dollar income for the region. It should be pointed out, however, that the costs of all goods and service as measured by the consumer price index is also expected to rise during this period. Figure VI-13 shows an extrapolation of the consumer price index to the year 2000. This graph indicates that goods and services in the year 2000 are likely to cost some 76 percent more than the same items do today. Thus, even when the increased costs of goods and services are accounted for, the average individual would still be in possession of some 42 percent additional real disposable income than at present. This projected increase of 42 percent in real disposable income appears conservative in the light of recent history. According to L.A. Mayer, reporting in the December 1967 issue of Fortune, real disposable income rose about 43 percent between 1959 and 1967. This rapid increase was brought about by a cyclical upturn and effects of the Vietnam war. The extrapolation to the year 2000 is based on the assumption of no major wars or recessions.

As the affluence of our society increases, discretionary income will be distributed to various markets. Among these will be improved waste management systems. People will hopefully be willing to spend a greater portion of their income to enhance convenience in handling solid wastes and to improve their environment. The amount society will be willing to spend for waste management is also a function of education which can point to extra conveniences and the reduction in damaging environmental effects in any proposed advanced system.

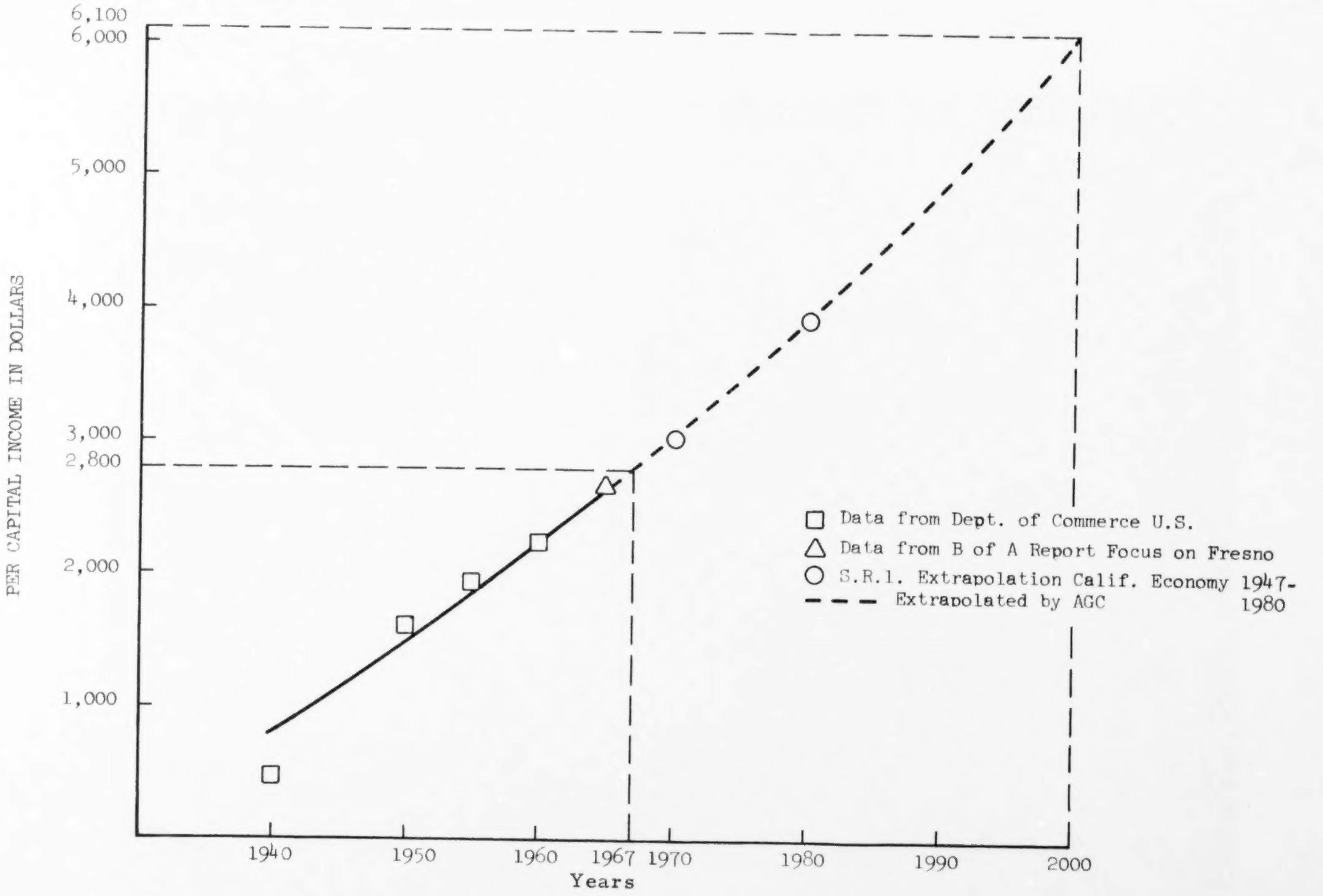


Figure VI-12. Projected Per Capita Income for Fresno County

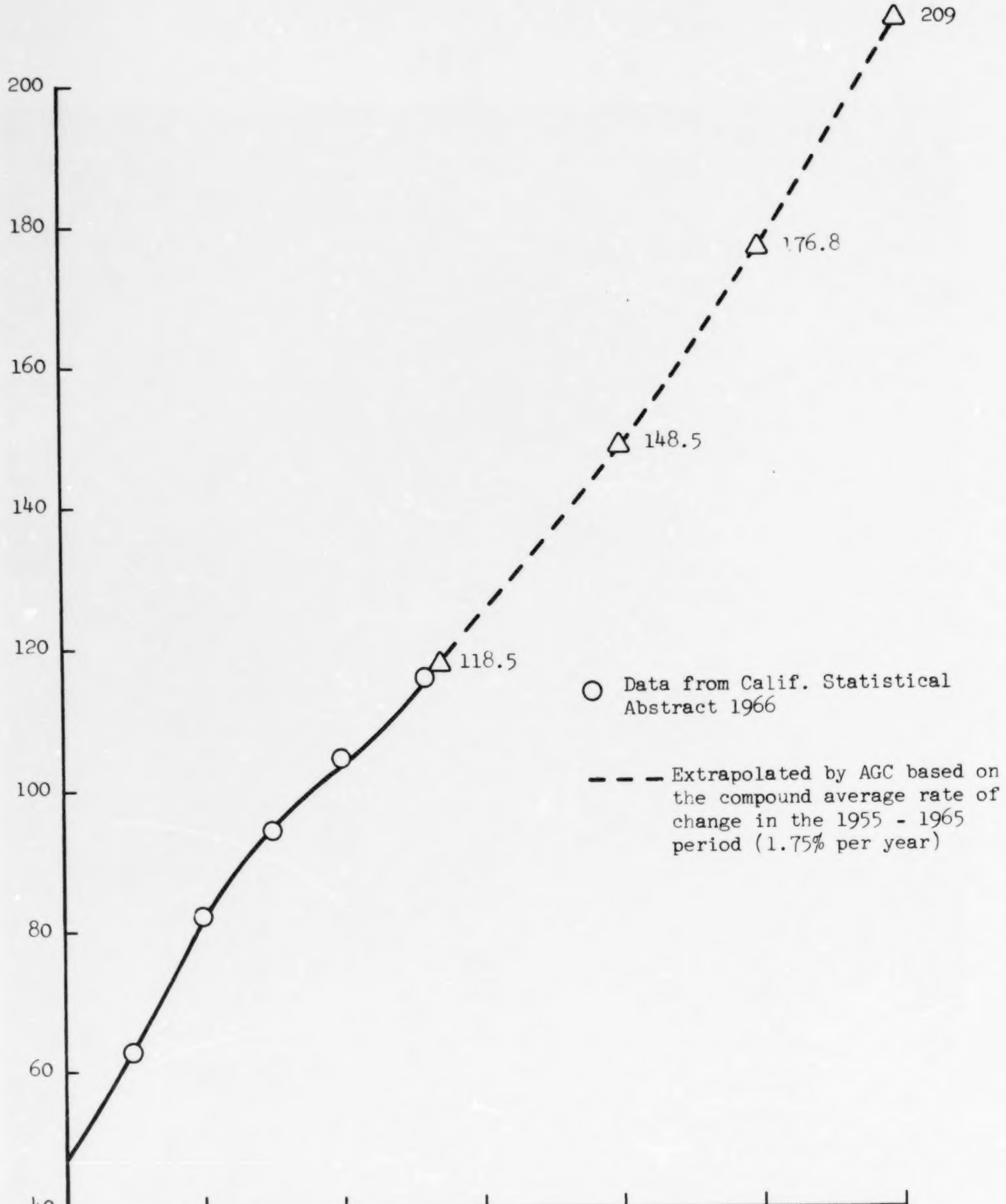


Figure VI-13. Extrapolated Consumer Price Index (with Base of 100 in the 1957 - 1959 Period)

Expenditures for handling solid wastes in the study region currently exceed 10 million dollars annually. This represents almost one percent of the existing income. Due to the factors discussed above, it can be hopefully anticipated that society would be willing to spend twice that amount (2 percent) by the year 2000. The annual allocation of 130 million dollars by the year 2000 to manage solid wastes should provide sufficient opportunity for gross environmental improvements by virtue of superior solid waste handling methods. Accounting for the expected inflation still leaves over 70 million present day value dollars per year to improve the existing solid waste management system. The cost of the existing system, extrapolated to the year 2000, would exceed 33 million dollars per year with no improvement in the environmental pollution situation caused by solid wastes.

b. Assessed Valuation

The total present assessed valuation for the Fresno Region is approximately $608 million. If assessed valuation climbs in proportion to total region income, the valuation in the year 2000 could be expected to be almost 4 billion dollars. This provides a base for short-term bond issues for the financing of waste management capital cost facilities. Table VI-24 is a breakdown of the assessed valuation for the central area of Fresno County for the year 1966-67.

4. Technical and Cost

The current processes and techniques, available equipment, and promising advanced concepts of solid waste management and their associated costs were described in considerable detail in Appendix B, Volume II, of the Interim report. For purposes of analysis, solid waste management systems were divided into five major functions: storage, collection, transportation, processing, and disposal.

a. Storage

The storage function includes all facilities and appurtenances used to accumulate and hold the solid wastes at either (1) their

Table VI-24

1966-67 ASSESSED VALUATION FOR FRESNO COUNTRY CENTRAL AREA

High School District	County Assessed Value Unsecured	County Assessed Value Secured	State Value	Total Secured	Total Value
Clovis Unified	$1,584,960	$36,083,730	$3,800,370	$39,884,100	$41,469,060
Friant Elem.	171,360	904,840	125,400	1,030,240	1,201,600
Fresno Unified	29,555,450	276,696,640	41,339,690	318,036,330	347,591,780
Sanger Unified	2,925,920	34,458,780	4,360,750	38,819,530	41,745,450
Fowler Unified	1,062,680	14,910,560	2,358,160	17,268,720	18,331,400
Laton Unified (Except Kings Co.)	200,200	4,832,000	823,350	5,655,350	5,855,550
Parlier Unified	96,970	5,137,010	708,650	5,845,660	5,942,630
Selma Unified	1,428,150	19,645,980	4,292,160	23,938,140	25,366,290
Caruthers H.S.	2,344,470	12,376,420	1,971,010	14,347,430	16,691,900
Central Union	2,235,330	21,736,060	4,595,790	26,331,850	28,567,180
Kerman H.S.	684,370	16,462,050	2,040,570	18,502,620	19,186,990
Kingsburg H.S. (Except Kings Co.)	1,355,510	14,863,220	1,332,320	16,195,540	17,551,050
Riverdale H.S. (Except West Side)	712,730	12,360,400	2,107,010	14,467,410	15,180,140
Washington H.S.	914,560	19,197,120	3,097,730	22,294,850	23,209,410
Totals	$45,272,660	$489,664,810	$72,952,960	$562,617,770	$607,890,430

respective places of generation or production (i. e., source storage), (2) any transfer point within the solid wastes removal and disposition system, or (3) any transfer point between the major operations of removal, collection, transportation, predisposal processing, or disposal. The storage function does not include in-transit or in-process storage.

Storage is accomplished by three major systems: manufactured portable containers, constructed-in-place containers, and open storage areas. In general, the only technical restraints to storage systems are cost, effectiveness in reducing nuisances, and associated handling cost for collection.

In terms of total cost per cubic yard of container capacity per year, storage costs range from $2 to $120. The median costs are those incurred for the galvanized metal garbage can. This cost approximates $8 to $22 per cubic yard of storage capacity per year.

b. Collection

The collection function has been defined to include pick-up collection and collection transportation or local haul. The function includes all facilities and equipment necessary to (1) pick up accumulated and/or stored solid waste materials from places of generation or production, and (2) transfer of these materials to a principal point or points of disposal, predisposal processing, or a transfer station. These collection facilities include sewers to which refuse materials may have been diverted.

Collection has two components: (1) the pick-up and loading process and (2) local transportation. Local transportation can be further subdivided into sub-unit operations, namely, hauling and unloading.

The principal systems utilized in the collection function are organized into the following categories.

(a) Hand portable equipment
(b) Powered vehicular systems
(c) Pneumatic equipment systems

(d) Liquid transport systems (including sewer and other waste water pipelines)

(e) Conveyor belt systems

(f) Water transport systems

While all of the above systems have been developed sufficiently to demonstrate feasibility, many minor and some major problems exist in the categories of pneumatic equipment systems, liquid transport, and conveyor belt systems. These include the problems of bulky wastes, heavy metal components, etc., as well as very substantial initial investment in pneumatic and conveyor systems. Liquid systems, incorporating sewers, would use an existing sanitary system but would require changes in household equipment and procedures to make possible the grinding of the majority of rubbish for sewer transport; an auxiliary collection system to handle nongrindable rubbish components would still be required. In addition, the effect on sewage treatment plant capacity could require substantial additional capital investment.

For general collection of municipal refuse, the reported total costs range from about $8 to $25 per ton of refuse collected. The median range is about $10 to $16 per ton. It should be noted that the cost ranges include large variations in local labor costs, type of equipment used, and degree of service supplied.

Street sweeping costs have been reported as ranging from $1 to $4 per curb mile swept.

c. Transportation

Transportation in this study is considered as that part of a community's solid waste management system that is composed of facilities and equipment necessary to transport or transfer accumulated and/or collected solid waste materials between any two other major functions in the total solid waste management system. Transportation could be between (1) collection and disposal or predisposal processing. (2) between processing and disposal, or (3) between any two sites within any major functional operation. Since the collection function involves a significant amount of transportation some of the major unit operations of collection also apply to the transportation function. The major methods of transportation have been organized into the following categories:

(a) Motor Transport Systems
(b) Pneumatic Systems
(c) Conveyor Belt Systems
(d) Rail Transport Systems
(e) Liquid Transport Systems
(f) Waterborne Transport Systems
(g) Transfer Stations

Almost every present day solid waste management system uses motor transport to some extent, and systems exist using rail transport, waterborne transport and transfer stations. The use of sewers to carry ground garbage and sludge pumping through ocean outfalls are examples of present use of liquid transport systems; however, the extension of the use of liquid transport to a larger portion of the waste generated is definitely an advanced concept, as are pneumatic systems and conveyor belt systems. The present technical problems limiting the use of these systems have been delineated in the discussion under the collection heading.

Motor transport costs have been reported in the range of about \$0.06 to \$0.10 per ton mile. They average about \$0.08 per ton mile.

Rail transport costs for solid waste in an area where rail transportation is available would range from \$0.008 to \$0.01 per ton mile. Wide variations from these values are possible since rates are controlled and, in most regions, railroads have had little or no experience with refuse handling.

The cost for operation of transfer stations can be expected to range from \$0.35 to \$2.60 per ton depending on the sophistication of the system employed.

d. Processing

The processing function in this study is considered to be composed of all those facilities, operations, and equipment necessary to change the physical and/or the chemical state or condition of the solid wastes in order to facilitate their subsequent collection, transportation, or disposal. In almost all the literature dealing with refuse management, processing concepts are included under the general heading of disposal. In this study, the subtle difference between processing (or treatment) and disposal proper is considered important enough to warrant the distinction being made. The processing function includes waste water treatment facilities insofar as solid waste materials have been diverted to the waste water. Processing operations are considered between storage and collection, between collection and transportation, before storage, and between collection or transportation and disposal. The last position is the usual one considered when processing is discussed as part of disposal. Larger, more centralized processing operations more nearly qualify as disposal while the decentralized processing operations tend to be associated with the transient operation.

Refuse processing or treatment concepts have, for purposes of this study, been organized into the following major methods, unit operations, or unit processes:

(a) Chemical Oxidation-Combustion: Central Municipal Incineration

(b) Chemical Oxidation-Combustion: Decentralized (on-site, at-source) Incineration

(c) Chemical Oxidation-Combustion: Open Burning

(d) Chemical Oxidation: Wet Air Oxidation

(e) Pyrolysis, Destructive Distillation, Miscellaneous Oxidation Processes

(f) Biochemical Oxidation: Composting

(g) Biochemical Oxidation: Anaerobic Processes

(h) Garbage Cooking

(i) Physical Size Reduction: Grinding, Crushing, Shredding, Chipping, and Pulverization

(j) Physical Size Reduction: Pulping

(k) Physical Volume Reduction: Baling and Compaction

(l) Physical Volume Reduction: Dewatering

(m) Salvaging-Reclamation-Reuse-Physical Separation Processing

All the above unit processes are presently in use to some degree in various waste management systems. Many are still in purely developmental categories. The technical problems involved in the implementation of any of the above processes are fairly well known and present no great barrier to their adaptation to overall system implementation. The major technical problem inherent to the combustion systems is in the incident production of air pollution, while the systems oriented toward salvage, reuse, or useful product production are economically marginal in the current affluent society.

Representative costs for some of the above processes are as outlined below.

Central incineration has been reported to cost from \$4 to \$10 per ton of refuse burned. The lower ranges of cost are exhibited by the newer, continuous-type innovations. Portable and field-erected incinerators for decentralized, at-source use, cost about \$12 per pound of refuse burning capacity per hour to install, and about \$0.50 per hour to operate. Unit values reported for industrial and sludge incinerators range from \$9 to \$38 per ton of material burned; with the sludge incinerator operating in the higher ranges.

Wet oxidation unit values have been estimated to range from about \$4 to \$30 per ton. The median reported values are about \$6 to \$20 per ton of material oxidized.

Composting unit operating values have been variously reported at $4 to $15 per ton of material processed. More specific reported values indicate an average range of about $5 to $7 per ton.

Central garbage grinding installations have been estimated to operate in the area of $0.90 to $1.40 per ton of material processed. These values would be lower if such grinding installations were integrated with sewage treatment plants. Central pulverization plants, on the other hand, operate in the range of $2.00 to $3.50 per ton of material processed. If salvage operations are integrated with the pulverization plant, the costs are increased to $4 to $5 per ton of material processed.

e. Disposal

The major refuse management function of disposal is the final and ultimate step in a community's solid wastes management system. The disposal function includes all those facilities, operations, and equipment necessary to incorporate the collected solid wastes or the end products of predisposal processing into the geophysical and ecological patterns of nature and/or the socioeconomic operations of the economy.

The following major disposal methods are generally practiced:

(a) Sanitary Landfilling
(b) Open Dumping
(c) Sub surface Disposal
(d) Ocean Disposal
(e) Atmospheric Disposal
(f) Land Spreading
(g) Animal Feeding

The above methods of disposal, except subsurface disposal, have been in general use for many years. The feasibility of subsurface disposal (pressure injection of slurried wastes) is currently under investigation at the University of Wyoming. The technical problems incident to the operation of the above systems are, in general, interface problems with land, water and air. Leachates from open dumps and sanitary landfills can pollute surface and groundwater when these sites are improperly located. Smoke and combustion products of burning add to air pollution, as does odor from open dumping and animal feeding operations. Land spreading and discing into the soil can temporarily deplete nitrogen and can also magnify plant diseases. Offshore ocean dumping often results in polluted shores and beaches.

The costs of ultimate disposal practices commonly used in the study region are as follows:

Sanitary Landfilling ---$1.14 to $1.27 per ton
Ocean Dumping --- $0.50 per ton
Land Spreading --- $0.45 to $2.90 per ton
Animal Feeding --- $0.17 per ton

Ocean disposal is not practiced in the study region because of distance and consequent transportation costs. Disposal to air by incineration and open burning is discussed in the preceding section.

In the Fresno Region, sanitary landfilling, open dumping, and open burning are currently utilized for municipal wastes. These three methods, as well as land spreading and animal feeding, are used for industrial wastes. Open burning, land spreading, and animal feeding provide the means for disposing of agricultural wastes. Postulated systems will not utilize open dumping, or open burning.

H. CONCLUSION

The "Operating Conditions" section of this report has described in summary form the parameters and limitations to be considered in synthesizing management systems for the Fresno Study Region. The restrictions to the operation of virtually any proposed solid waste management system are, in reality, a function of the community's desire to reduce the environmental effects of solid wastes. By the judicious use of legislation in combination with adequate funding almost any desired degree of freedom from deleterious environmental effects is attainable.

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VII. CONCEPTUAL DESIGN OF SYSTEMS

A. OBJECTIVE

The objective of this section is to present basic systems that appear most applicable to solid waste management in the Fresno region and to delineate these various systems in sufficient detail to permit their evaluation in terms of cost, performance, and "A" scores. The conceptual design of each system was synthesized from the most acceptable methods and procedures developed in "Candidate Waste Management Concepts," Appendix D, Volume III. The number of design concepts to be considered was dictated by the necessity of presenting systems significantly different in design and operation as to be representative of all the alternatives compatible with existing and future operating conditions and technology. Existing waste management systems in the Fresno region have been included for comparitive purposes.

The "performance scoring procedure" developed in Section IV includes four major functions which must be scored: storage, transport, processing, and disposal. In this procedure, storage has 5 scorable variations, transport 2, processing 6, and disposal 5. These functions can be scored for municipal, industrial, agricultural and interface regions. There are 52 types of wastes which must be accounted for in any management system postulated for the Fresno region. If all of these variables remain, it would be possible to delineate (52 x 4 x 5 x 2 x 6 x 5) = 62,400 separate scorable systems. Time and budget limitations necessitated making engineering judgments to recast the potential systems into a workable number for analysis.

Systems for agricultural waste management have been discussed separately from systems for municipal and industrial waste management because agricultural wastes are not normally handled by systems integrated with municipal and industrial operations. This does not preclude integration of systems, it merely permits separate presentation and the simplification required for logical consideration of overall waste management systems.

B. MUNICIPAL AND INDUSTRIAL SYSTEMS

1. Discussion

a. Storage

The storage function includes all facilities and appurtenances used to accumulate and hold solid wastes at the place of generation (source storage), and those facilities and appurtenances employed at any transfer point between operations. The storage function does not include in-transit or in-process storage. Presently, the principal types of storage equipment include makeshift receptables, fabricated containers, bags and liner-bags, bin-type containers, and drop-body containers.

Open storage areas are unsuitable for storage of domestic and commercial solid wastes. Hence, it is assumed that all storage will be in closed containers with the exception of a few wastes such as metallic debris and demolition materials which do not pose any serious environmental problems.

Certain types of systems, such as comminution at the source, pneumatic systems, and direct discharge to the sewerage system, are capable of excluding the storage function completely.

The most appropriate parameters for the storage operation have been selected as follows:

(1) Conventional closed storage

(2) Storage in specialized containers

(3) No storage

The parameter "storage in special containers" includes storage functions where an automated pick-up operation requires specialized containers.

b. Collection and Transportation

Most of the costs in solid waste management are incurred in collection and transportation. The figures presented in Appendix D, Volume III, indicate that collection costs (residential) vary between $14.00 and $25.00/ton which may be compared to $1.00 to $2.50/ton for disposal by sanitary landfilling. A waste management system that materially reduces the collection and transportation costs would, therefore, be most advantageous.

The collection function has been defined to include pick-up collection and transportation between collection stops. Transportation has been considered as that part of a waste management system where accumulated and/or collected solid wastes are transported between major functions in the total waste management system.

Collection-transportation systems would include motor transport, rail transport, pipeline transport, and transportation by air. The "scoring procedure" accounts only for the distinction between "transportation open" and "transportation closed"; consequently, most transportation systems will be equally scored.

The most appropriate variables for the transportation operation have therefore been determined to be vehicular and pipelines.

(1) Vehicular Transportation: This category includes any vehicular collection as a transport operation. It assumes cost optimization of collection-transportation functions such that transfer stations may or may not be constructed as the least cost solution to the selected system design.

(2) Transport in Pipelines: Separate pneumatic pipeline systems for the transportation of solid wastes have been proposed and in a few cases constructed. The costs of such systems appear to be approximately thirty times the cost of standard vehicular systems, hence, further consideration of large scale pneumatic transportation systems seems precluded; however, use of such systems in total concepts integrated with other systems does have merit and should be considered in final designs.

The sewage system represents an existing transportation system with only a small portion of its capacity in use at any given time. The average sewage solids contribution per capita per day in sewage is about 0.4 to 0.6 pounds. Assuming a typical per capita sewage flow of 100 gallons per day, it is apparent that more than 1,600 pounds of water are used to transport only one pound of solids.

Thus, a solid waste management system that can make use of this already paid for and existing transportation system may be very economical. To accomplish this, modifications such as special flushings of flat sewers may be necessary. These preliminary assumptions require further investigation to determine the actual possibility of utilizing existing sewers to carry solid wastes.

Table VII-1 indicates the relative waste load coefficients for solids, BOD, total nitrogen, and total phosphorous in several combinations of sanitary sewage and solid waste transport in sewers.

Table VII-1

RELATIVE WASTE LOAD COEFFICIENTS

	Solids-Coeff.	BOD-Coeff.	N-Coeff.	P-Coeff.
Typical Sanitary Sewage	1.0	1.0	1.0	1.0
Home Garbage Grinders and Sanitary Sewage	3 to 4	1.4	1.2	1.2
Home Refuse Grinders and Sanitary Sewage	6 to 10	2.0	1.5	1.4

It is evident that the processing operation in the sewage treatment plant would require modification to manage the increased loadings if refuse solids are included.

c. Processing

When a particular transportation or disposal concept is selected, the applicability of various processing operations are dictated.

For example, processes which apply to sewage sludge are the processes of choice if refuse is transported in sewage; where landfilling is to be employed, it may be desirable to grind the refuse to achieve economy of space. Thus, if specific transportation and disposal alternatives are selected, an economic optimization process must be carried out to arrive at the final overall design including applicable processing. Processing techniques selected for application to various systems include incineration, composting, and no processing.

(1) Incineration: Incineration reduces the wet weight of municipal wastes by approximately 80 percent and the volume by approximately 90 percent; it is, however, an expensive operation (presently about 4 to 8 times more expensive than sanitary landfill). Costs can be expected to increase still more as increasing standards of air quality are established and enforced.

The overall costs of incineration can be reduced if the fuel value of solid wastes produces a financial return; incineration is more competitive when the heat energy can be productively used.

(2) Composting: Although many composting operations have not been successful, the potential benefits of composting cannot be overlooked. Most failures are caused by high initial operations cost and lack of market for the product. In an agricultural region such as Fresno, the need for soil trace mineral conservation and humus should result in a potentially favorable market for compost. Future values for humus to increase the productivity of soil for crops may show composting in an even more favorable light.

(3) No Processing: "No processing" assumes only incidental processing that is not basic to the concept.

d. Disposal

Ultimate disposal sites for any solid waste are the land, atmosphere, or the ocean. It is impractical, at this time, to consider the ocean as a disposal site for the Fresno region. Disposal to the atmosphere could handle a large fraction of the waste with resultant air pollution, but there are always solid residues requiring disposal to the land; therefore, land disposal must always be considered. It is assumed that only well-organized and carefully maintained operations are included in the sanitary landfill category.

e. Summary

The elements of management concepts that have been developed into possible combinations and overall plans are shown in Table VII-2. A total of eighteen combinations are scored and evaluated in Section VIII.

Table VII-2

COMBINATION OF CONCEPT-PARAMETERS
MUNICIPAL-INDUSTRIAL

Storage	Collection	Processing	Disposal
Conventional Storage		Incineration	
	Vehicular Collection and Transportation		
Special Storage		Composting	On land
	Transport in Sewer Lines		
No Storage		No Processing	

2. Systems Descriptions

To simplify the presentation, each system is presented on a flow chart. The chart indicates the in-flow disposition of each type of solid waste. The types of wastes are indicated by numbers at the left and the detailed list or key to all wastes is presented in Section III. The following summary of the list of wastes should prove helpful for reading the flow charts.

Waste No. 1 - garbage (food wastes)

Waste No. 2 & 3 - rubbish (residential & commercial)

Waste No. 4 - street sweepings

Waste No. 5 - dead animals (over 10 pounds)

Waste No. 7 - construction and demolition debris

Waste No. 9 - special wastes (pathological)

Waste No. 10 - sewage treatment residue

Waste No. 12 - ashes

Wastes No. 13 - human fecal wastes (toilets not connected to sewers, such as in recreation areas)

Wastes No. 16 to 80 - agricultural wastes

Wastes No. 86 to 102 - industrial wastes.

It should be noted that the 18 systems developed for municipal and industrial waste management can be combined with any one of the several alternative systems for the management of agricultural wastes.

The 18 postulated municipal and industrial systems along with the existing regional system are described in the following pages. In addition to a brief description, a statement of the basic characteristics and a flow chart for each system is presented.

a. System No. 1

This system is similar in many respects to the present operation. Wastes would be stored in closed containers and collected by compacter vehicles. There would be no processing and the wastes disposed of by sanitary landfilling. The basic improvements over the existing system (s.) are presented by elimination of open storage, open transportation, open burning, and open dumps.

(1) Characteristics

(a) Wastes stored in closed containers.

(b) Collection and closed transportation by motor vehicles.

(c) Processing limited to such operations as optimizing storage and disposal capacities.

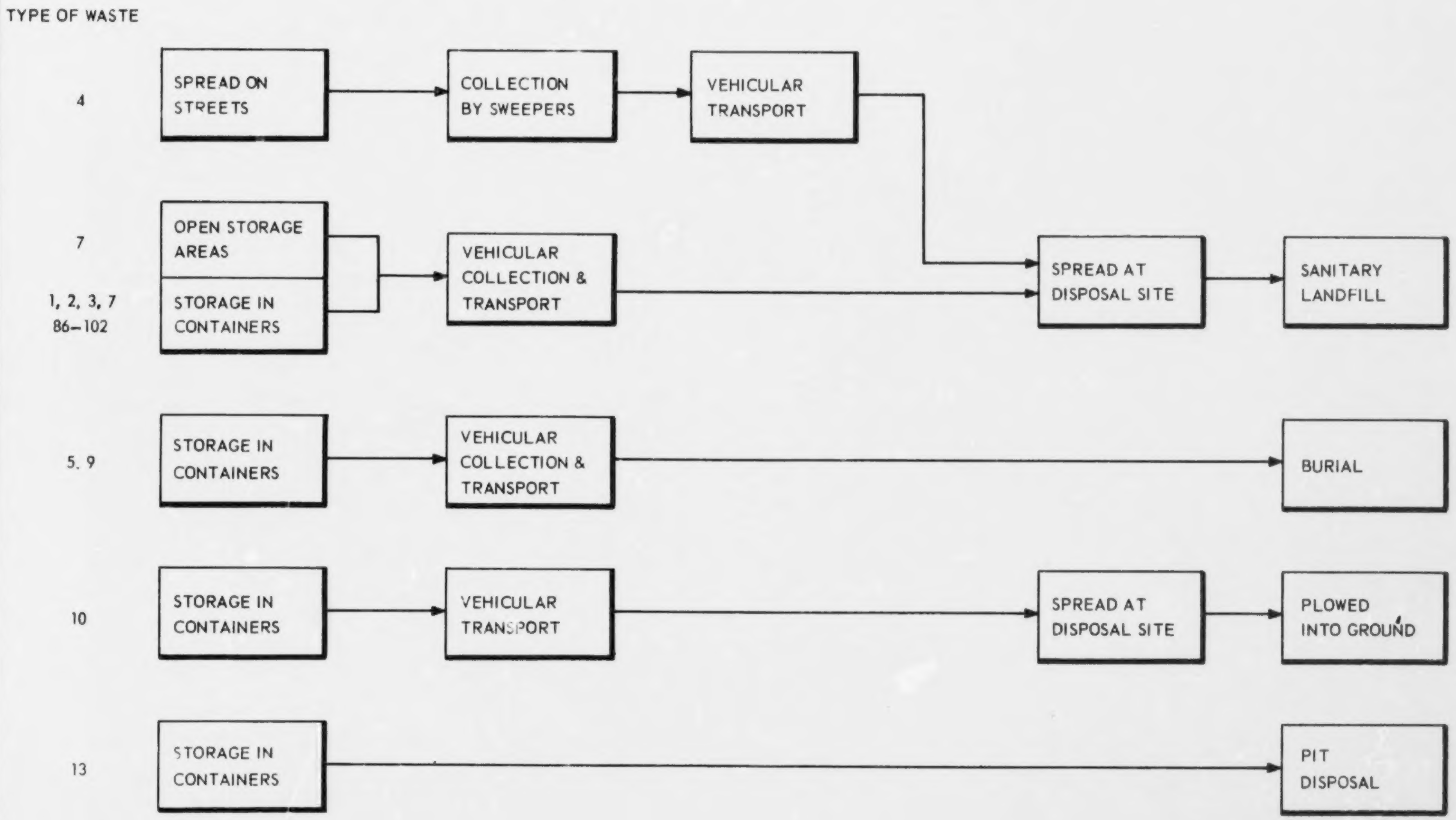
(d) Disposal of most wastes by sanitary landfilling.

(e) Dead animals (5) and special wastes (9) buried.

(f) Sewage treatment residues (10) managed by plowing into the ground.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. I


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
7
OPEN STORAGE AREAS
1, 2, 3, 7 86–102
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
5. 9
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
BURIAL
10
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
PLOWED INTO GROUND
13
STORAGE IN CONTAINERS
PIT DISPOSAL

b. System No. 2

This system is identical to System No. 1, with regard to storage, collection, and transportation. Incineration would be provided in this system as a waste process to primarily reduce the volume requirements for sanitary landfilling. Wastes would be stored in closed containers and collected by compacter vehicles. Combustible wastes would be incinerated. The incineration plant 's) would be optimized with regard to performance and the location of the plant(s) would be determined by optimizing the use of collection and transportation facilities.

(1) Characteristics

(a) Wastes stored in closed containers.

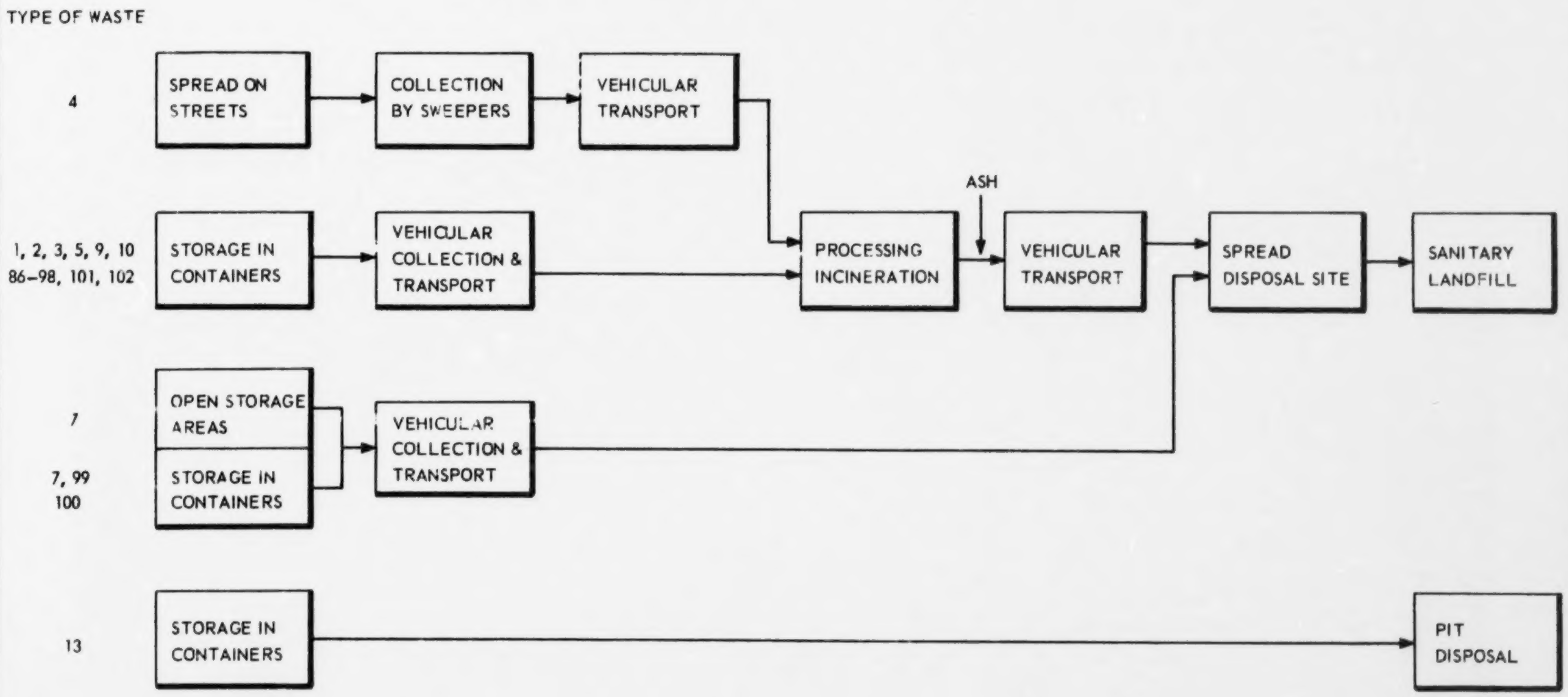
(b) Collection and closed transportation by motor vehicles.

(c) Incineration of all combustible wastes.

(d) Disposal of noncombustible wastes and incineration residues by sanitary landfilling.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 2


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
1, 2, 3, 5, 9, 10
86–98, 101, 102
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
ASH
PROCESSING INCINERATION
VEHICULAR TRANSPORT
SPREAD DISPOSAL SITE
SANITARY LANDFILL
7
OPEN STORAGE AREAS
7, 99
100
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
13
STORAGE IN CONTAINERS
PIT DISPOSAL

c. System No. 3

This system is similar to System No. 2, except that composting would be included as the process. Wastes would be stored in closed containers and collected by compacter vehicles. Amenable materials would be composted. The composting plant(s) would be optimized with regard to performance and the location of the plant(s) would be determined by optimizing the use of collection and transportation facilities.

(1) Characteristics

(a) Wastes stored in closed containers.

(b) Collection and closed transportation by motor vehicles.

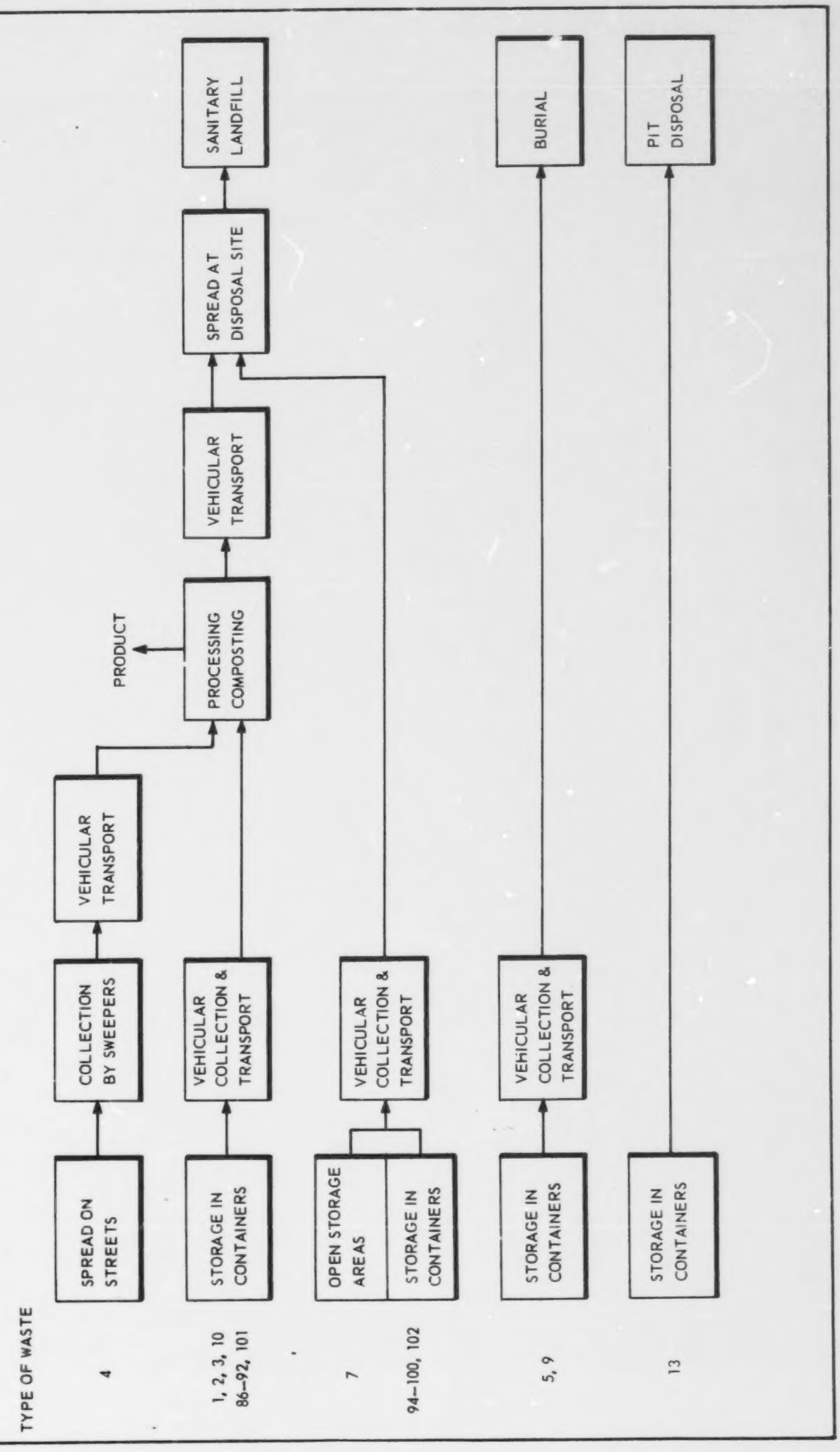
(c) Composting of bio-degradable materials. Compost leaves the waste stream at this point.

(d) Disposal of composting residues and materials not degradable by sanitary landilling.

(e) Dead animals (5) and special wastes (9) buried.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 3


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
1, 2, 3, 10
86–92, 101
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
PROCESSING COMPOSTING
PRODUCT
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
7
94–100, 102
OPEN STORAGE AREAS
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
5, 9
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
BURIAL
13
STORAGE IN CONTAINERS
PIT DISPOSAL

d. System No. 4

This system is characterized by the simplification of the collection operation. Wastes would be stored in special underground containers. Pick-up would be accomplished by vacuum-equipped collection vehicles eliminating handling of waste containers. The collected wastes would be transported by the collection vehicles and disposed of by sanitary landfilling.

(1) Characteristics

(a) Wastes stored in special containers.

(b) Automated pick up of wastes stored in special containers.

(c) Processing limited to such operations as optimizing storage and disposal capacities.

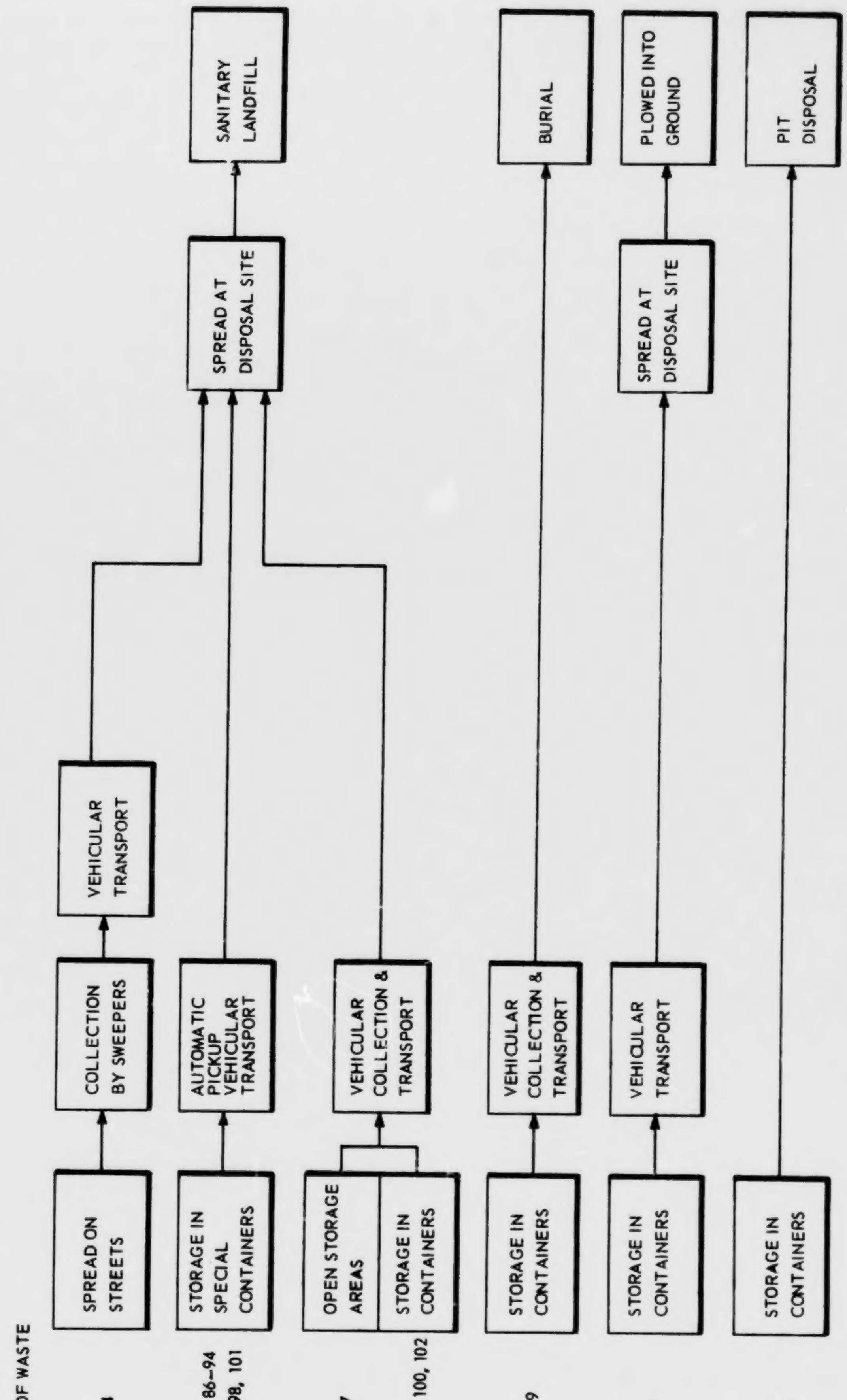
(d) Disposal of most wastes by sanitary landfilling

(e) Dead animals (5) and special wastes (9) buried.

(f) Sewage treatment residues (10) managed by plowing into the ground.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 4


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
1, 2, 3, 86–94
96, 97, 98, 101
STORAGE IN SPECIAL CONTAINERS
AUTOMATIC PICKUP VEHICULAR TRANSPORT
7
OPEN STORAGE AREAS
7, 95, 99, 100, 102
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
5, 9
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
BURIAL
10
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
PLOWED INTO GROUND
13
STORAGE IN CONTAINERS
PIT DISPOSAL

e. System No. 5

This system is identical to System No. 4 with regard to storage, collection, and transportation. Instead of disposal of all wastes by sanitary landfilling, all combustible wastes would be transported to a central incineration plant. The incineration plant(s) location would be determined by optimizing the use of collection and transportation facilities. Nonincinerable wastes, noncombustible wastes, and ash residue would be disposed of by sanitary landfilling.

(1) Characteristics

(a) Wastes stored in special containers.

(b) Automated pick up of wastes stored in special containers.

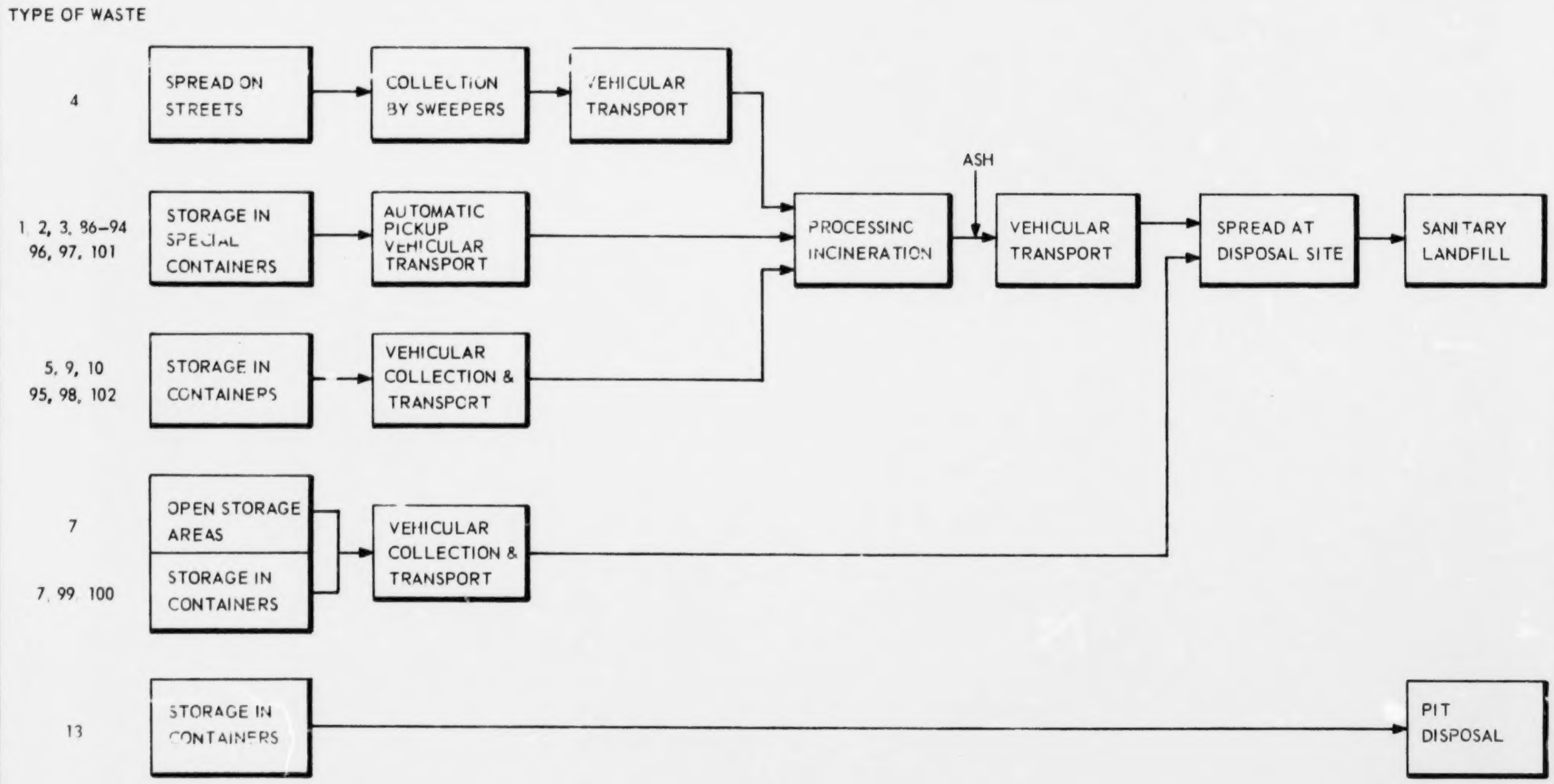
(c) Conventional storage and collection of wastes that cannot be stored in special containers.

(d) Incineration of all combustible wastes.

(e) Disposal of noncombustible wastes and incineration residues by sanitary landfilling.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 5


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
1, 2, 3, 86–94 96, 97, 101
STORAGE IN SPECIAL CONTAINERS
AUTOMATIC PICKUP VEHICULAR TRANSPORT
5, 9, 10 95, 98, 102
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
7
OPEN STORAGE AREAS
7, 99, 100
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
13
STORAGE IN CONTAINERS
PROCESSING INCINERATION
ASH
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
PIT DISPOSAL

f. System No. 6

This system is also identical to System No. 4 as to storage, collection, and transportation. The collected wastes would be transported to a composting plant, where bio-degradable materials would be converted to compost. The plant(s) would be optimized in regard to performance and the location of the plant(s) would be determined by optimizing the use of collection and transportation facilities.

(1) Characteristics

(a) Wastes stored in special containers.

(b) Automated pick up of wastes stored in special containers.

(c) Conventional storage and collection of wastes that cannot be stored in special containers.

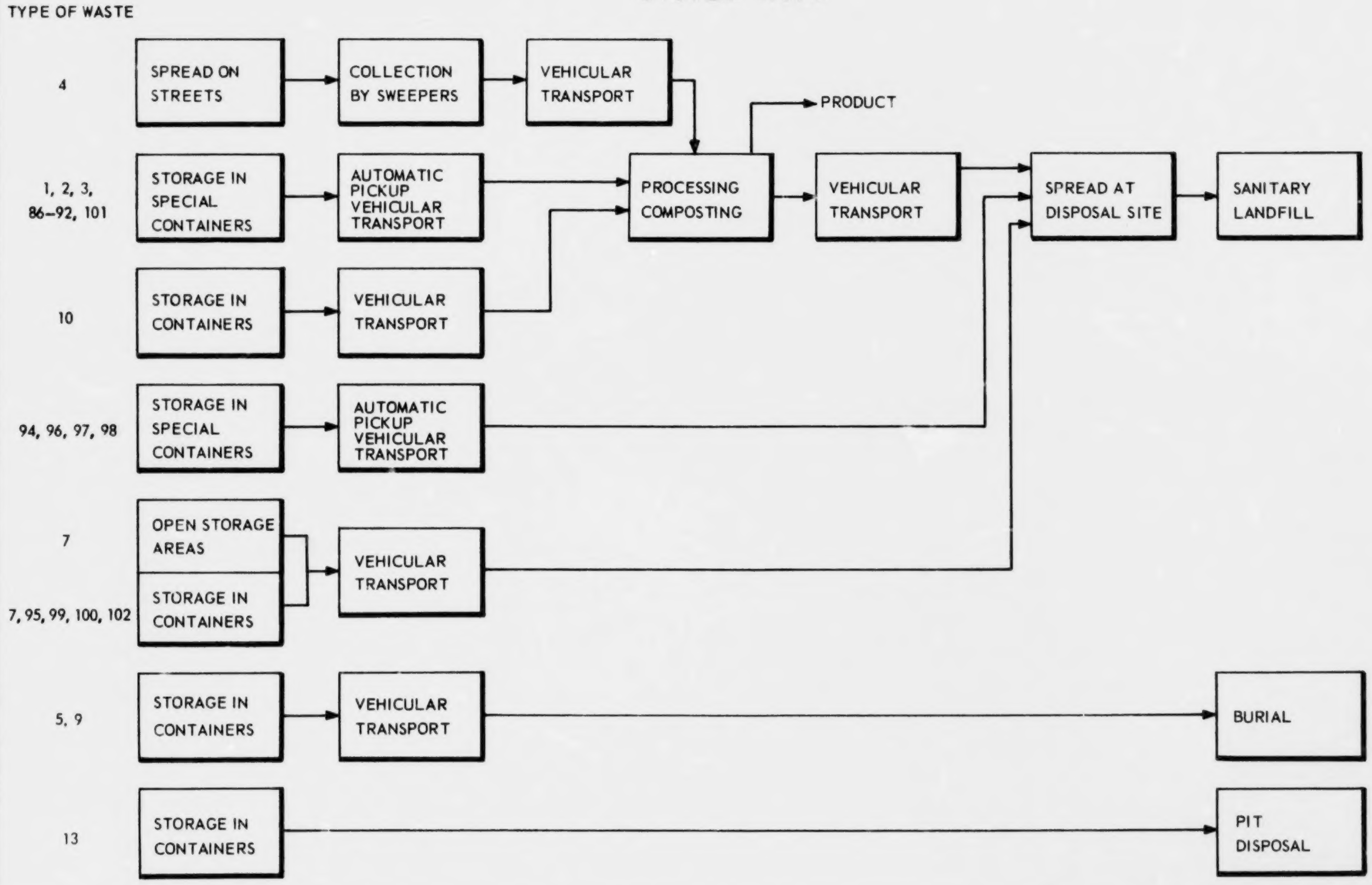
(d) Composting of bio-degradable materials. Compost leaves the waste stream at this point.

(e) Disposal of composting residues and materials that cannot be composted by sanitary landfilling.

(f) Dead animals (5) and special wastes (9) buried.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 6


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
PRODUCT
1, 2, 3, 86–92, 101
STORAGE IN SPECIAL CONTAINERS
AUTOMATIC PICKUP VEHICULAR TRANSPORT
PROCESSING COMPOSTING
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
10
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
94, 96, 97, 98
STORAGE IN SPECIAL CONTAINERS
AUTOMATIC PICKUP VEHICULAR TRANSPORT
7
OPEN STORAGE AREAS
7, 95, 99, 100, 102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
5, 9
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
BURIAL
13
STORAGE IN CONTAINERS
PIT DISPOSAL

g. System No. 7

This system is characterized by the partial elimination of storage and manual collection. Domestic and some industrial wastes would be ground at their source, and the ground materials discharged into the sewers. The grinders would be "home-units," comparable in size with a washing machine. It has been assumed that these grinders would handle about 80 percent of the wastes generated in a household. The sewage treatment plant(s) would require modification to handle the increased amount of solids. Sewage treatment plant residue would be disposed of in sanitary landfills.

(1) Characteristics

(a) Partial elimination of storage; wastes discharged into the sewerage system.

(b) Conventional storage and collection of solid wastes that cannot be ground in home units.

(c) Sewage treatment processes for wastes that are transported in sewer lines.

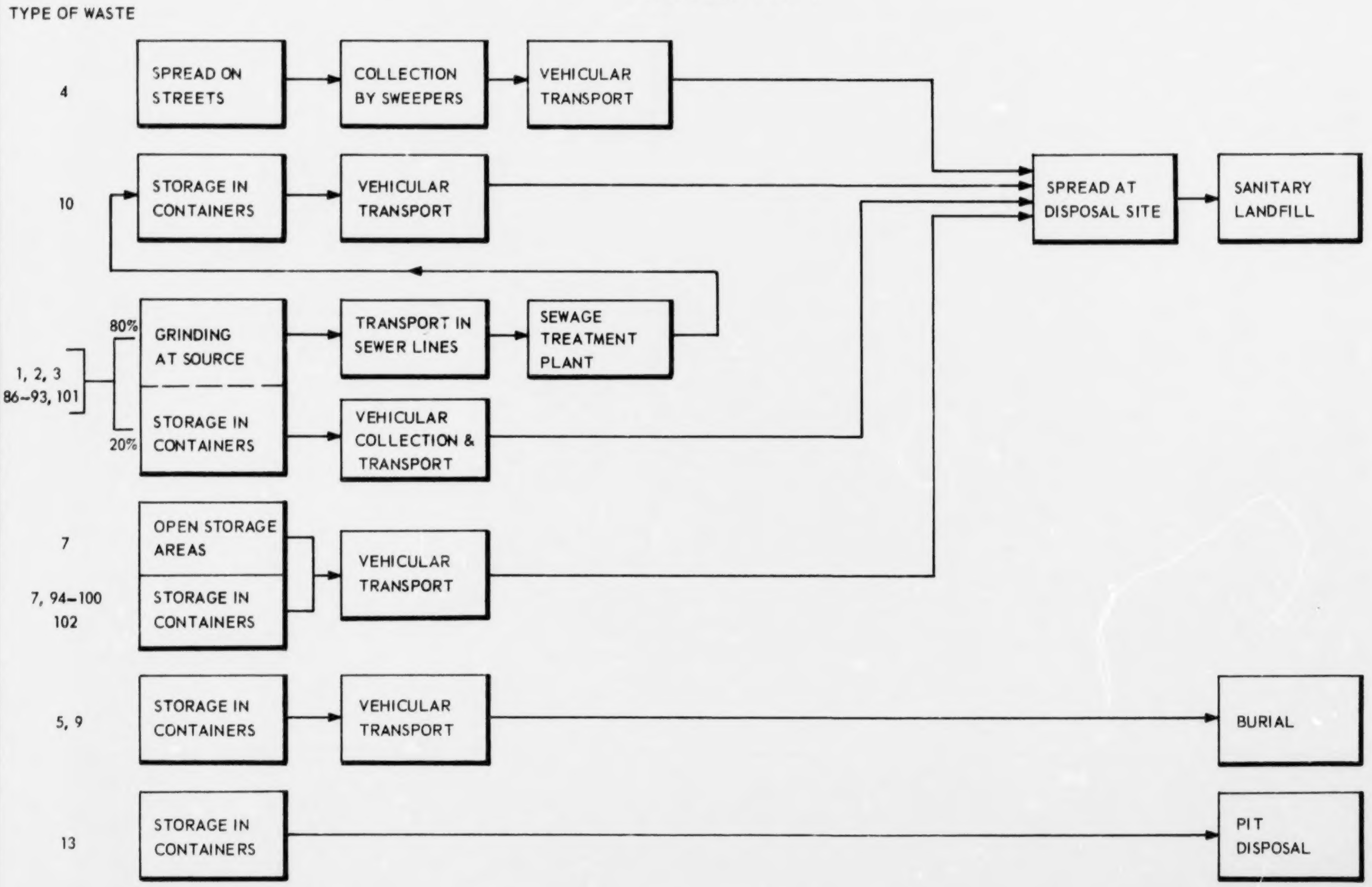
(d) Processing limited to such operations as grinding at the source and optimizing disposal capacities.

(e) Disposal of conventionally collected wastes by sanitary landfilling.

(f) Dead animals (5) and special wastes (9) buried.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 7


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
10
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
1, 2, 3
86–93, 101
80%
GRINDING AT SOURCE
TRANSPORT IN SEWER LINES
SEWAGE TREATMENT PLANT
20%
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
7
OPEN STORAGE AREAS
7, 94–100
102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
5, 9
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
BURIAL
13
STORAGE IN CONTAINERS
PIT DISPOSAL

h. System No. 8

This system is identical to System No. 7, except that sewage treatment plant residue would be incinerated. Nonincinerable wastes, noncombustible wastes, and ash residue would be disposed of in sanitary landfills.

(1) Characteristics

(a) Partial elimination of storage; wastes discharged into the sewerage system.

(b) Conventional storage and collection of solid wastes that cannot be ground in home units.

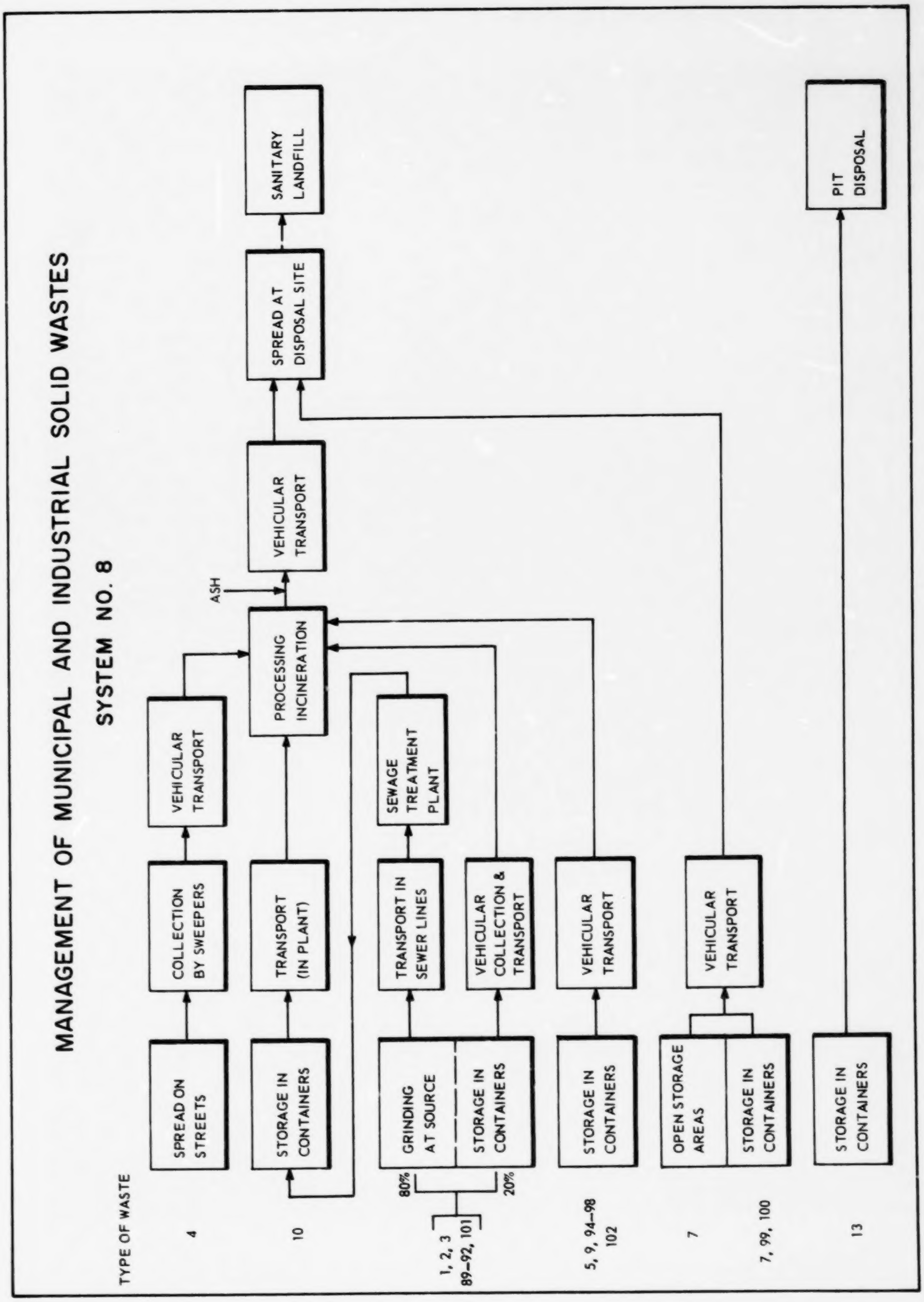
(c) Sewage treatment processes for wastes that are transported in sewer lines.

(d) Incineration of the increased amount of sludge (10), combined with incineration of combustible wastes that cannot be ground by home units.

(e) Disposal of noncombustible wastes and incineration residues by sanitrary landfilling.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 8


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
10
STORAGE IN CONTAINERS
TRANSPORT (IN PLANT)
PROCESSING INCINERATION
ASH
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
1, 2, 3
89–92, 101
80%
20%
GRINDING AT SOURCE
STORAGE IN CONTAINERS
TRANSPORT IN SEWER LINES
SEWAGE TREATMENT PLANT
VEHICULAR COLLECTION & TRANSPORT
5, 9, 94–98
102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
7
7, 99, 100
OPEN STORAGE AREAS
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
13
STORAGE IN CONTAINERS
PIT DISPOSAL

i. System No. 9

This system is identical to System No. 8, except that sewage treatment plant sludge would be composted. The composting plant and the sewage treatment plant would be integrated into a single unit. Non-biodegradable material and compost residue would be disposed of in sanitary landfills.

(1) Characteristics

(a) Partial elimination of storage; wastes discharged into the sewerage system.

(b) Conventional storage and collection of solid wastes that cannot be ground in home units.

(c) Sewage treatment processes for wastes that are transported in sewer lines.

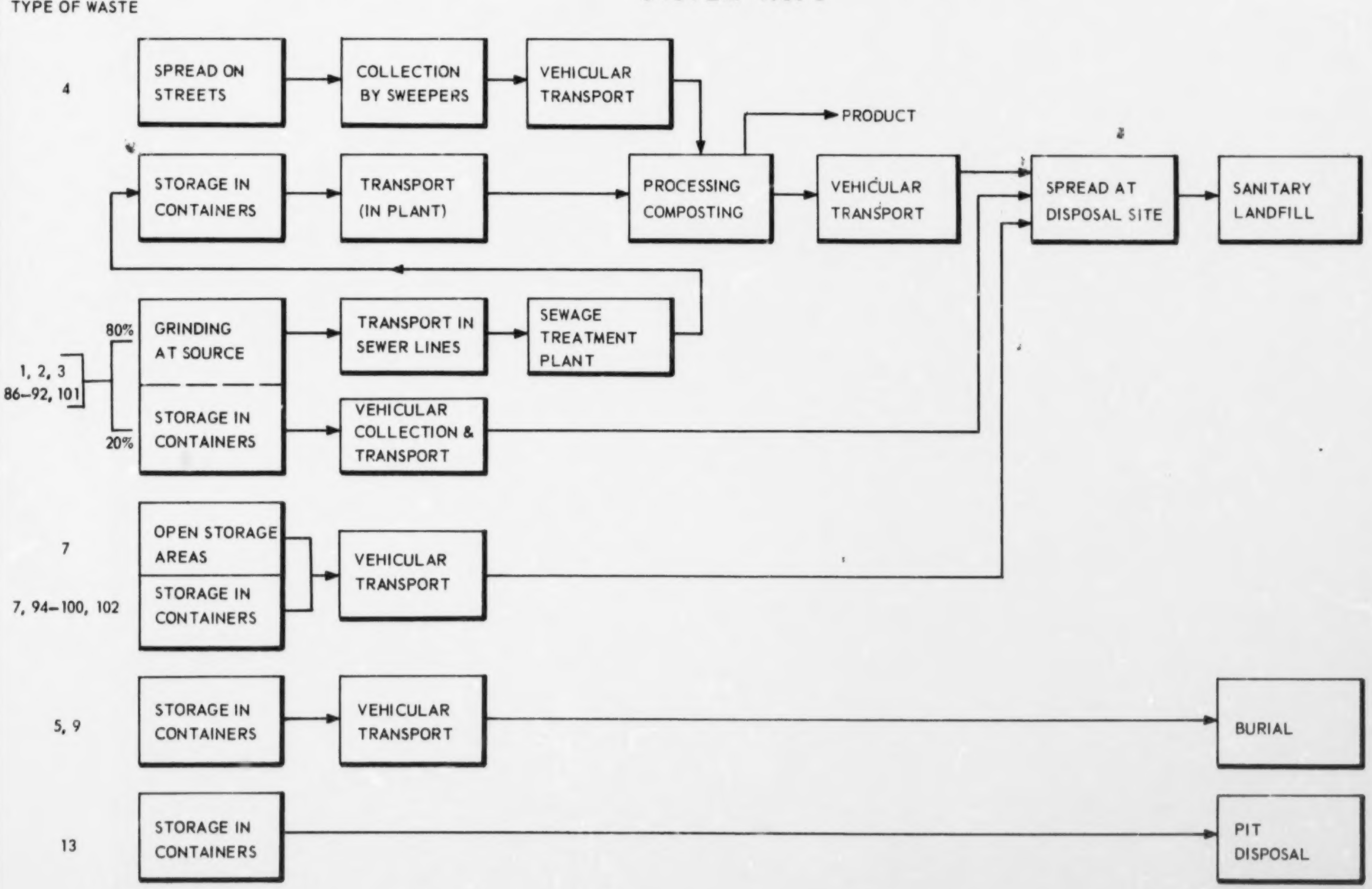
(d) Composting of the increased amount of sludge (10), combined with composting of other amenable materials that cannot be ground in local units.

(e) Disposal of composting residues and other materials that cannot be composed by sanitary landfilling.

(f) Dead animals (5) and special wastes (9) buried.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 9


TYPE OF WASTE
4
1, 2, 3
86–92, 101
7
7, 94–100, 102
5, 9
13
80%
20%
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
STORAGE IN CONTAINERS
TRANSPORT (IN PLANT)
PROCESSING COMPOSTING
PRODUCT
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
GRINDING AT SOURCE
TRANSPORT IN SEWER LINES
SEWAGE TREATMENT PLANT
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
OPEN STORAGE AREAS
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
BURIAL
STORAGE IN CONTAINERS
PIT DISPOSAL

j. System No. 10

This system is characterized by the elimination of storage and manual collection. Domestic and some industrial wastes would be aggregated by a pneumatic system. The aggregated wastes would then be ground at decentralized grinding stations. The stations would be optimized with respect to the number of waste producers and relative costs. Ground wastes would be discharged into the sewers. Sewage treatment plant(s) would require modification to process the increased load of solids. Sewage treatment plant sludge would be disposed of by sanitary landfilling.

(1) Characteristics

(a) Elimination of storage and manual collection.

(b) Wastes collected by a pneumatic system and ground at centralized grinding stations.

(c) Conventional storage and collection of wastes that cannot be collected pneumatically.

(d) Ground wastes discharged into the sewerage system.

(e) Sewage treatment processes for wastes that are transported in sewer lines.

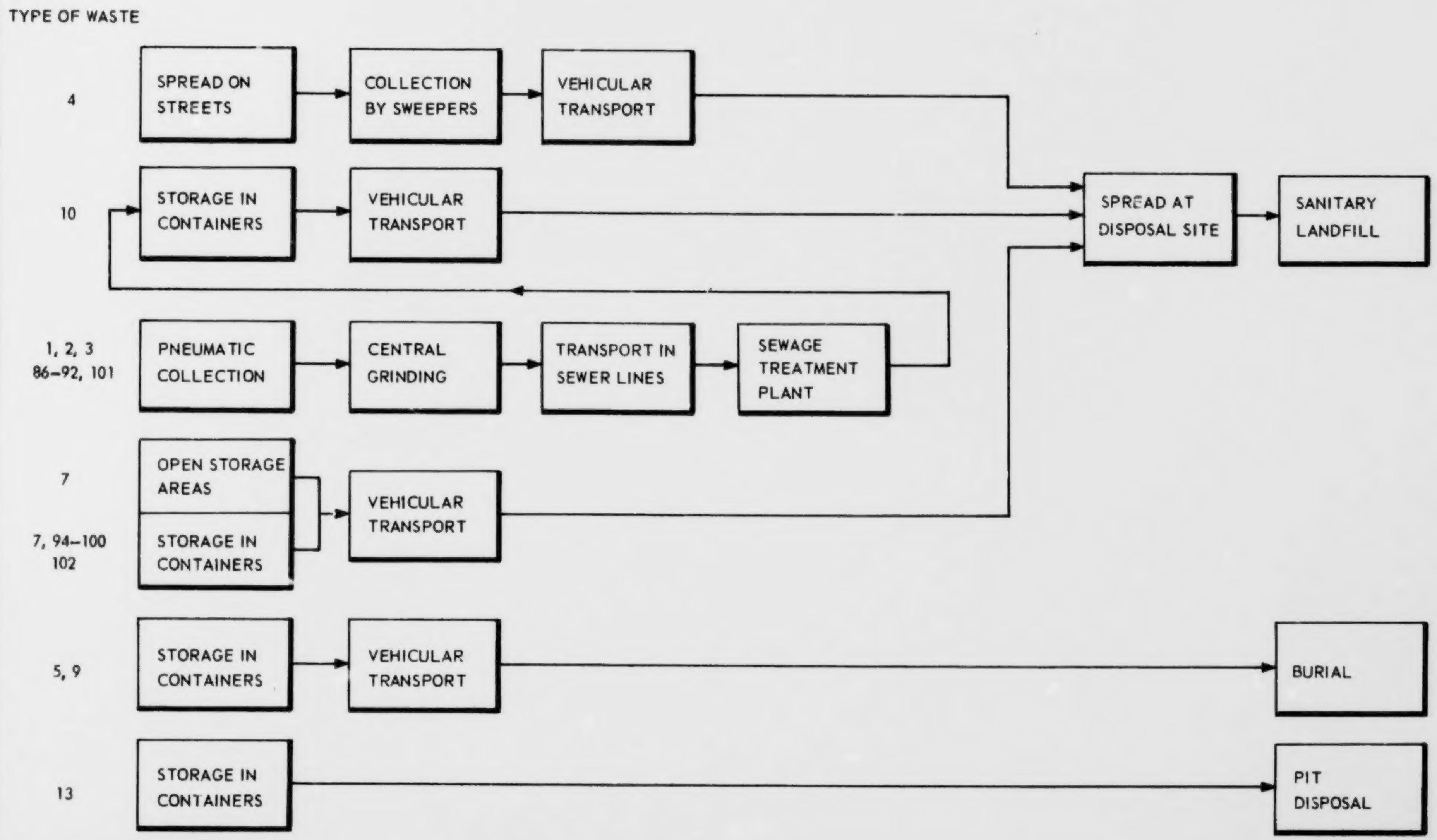
(f) Processing limited to such operations as grinding at the source and optimizing disposal capacities.

(g) Disposal of conventionally collected wastes by sanitary landfilling.

(h) Dead animals (5) and special wastes (9) buried.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 10


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
10
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
1, 2, 3
86–92, 101
PNEUMATIC COLLECTION
CENTRAL GRINDING
TRANSPORT IN SEWER LINES
SEWAGE TREATMENT PLANT
7
OPEN STORAGE AREAS
7, 94–100
102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
5, 9
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
BURIAL
13
STORAGE IN CONTAINERS
PIT DISPOSAL

k. System No. 11

This system is identical to System No. 10, except that sewage treatment plant sludge would be incinerated; the incineration plant and sewage treatment plant would be integrated into a single operation.

(1) Characteristics

(a) Elimination of storage and manual collection.

(b) Wastes collected by a pneumatic system and ground at centralized grinding stations.

(c) Conventional storage and collection of wastes that cannot be collected pneumatically.

(d) Ground wastes discharged into the sewerage system.

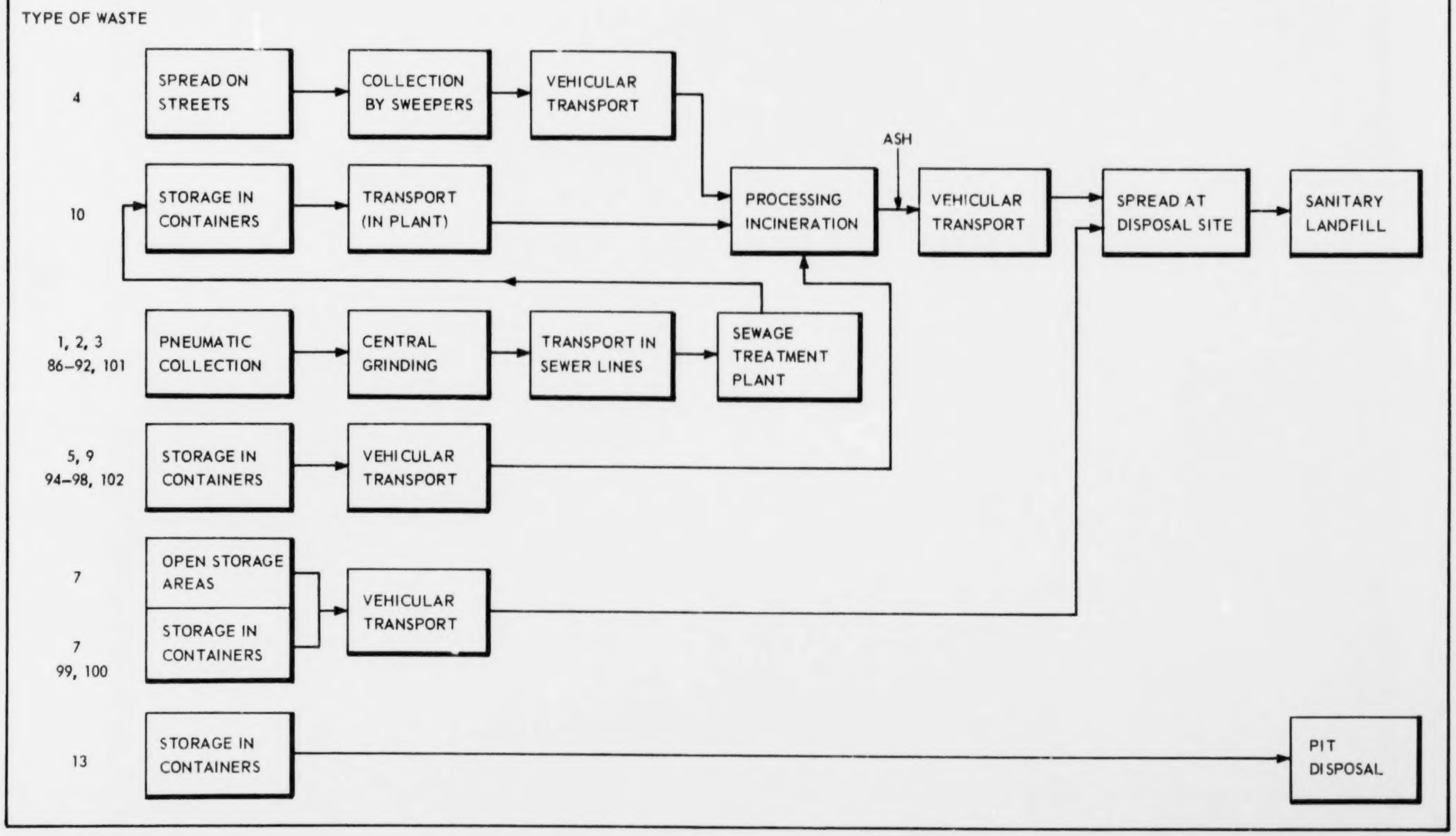
(e) Sewage treatment processes for wastes that are transported in sewer lines.

(f) Incineration of the increased amount of sludge (10), combined with incineration of other combustible materials.

(g) Disposal of noncombustible wastes and incineration residues by sanitary landfilling.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. II


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
10
STORAGE IN CONTAINERS
TRANSPORT (IN PLANT)
PROCESSING INCINERATION
ASH
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
1, 2, 3
86–92, 101
PNEUMATIC COLLECTION
CENTRAL GRINDING
TRANSPORT IN SEWER LINES
SEWAGE TREATMENT PLANT
5, 9
94–98, 102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
7
OPEN STORAGE AREAS
7
99, 100
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
13
STORAGE IN CONTAINERS
PIT DISPOSAL

1. System No. 12

This system is identical to System No. 11, except that sewage treatment plant sludge would be composted; the composting plant and sewage treatment plant would be integrated into a single operation.

(1) Characteristics

(a) Elimination of storage and manual collection.

(b) Wastes collected by a pneumatic system and ground at centralized grinding stations.

(c) Conventional storage and collection of wastes that cannot be collected pneumatically.

(d) Ground wastes discharge into the sewerage system.

(e) Sewage treatment processes for wastes that are transported in sewer lines.

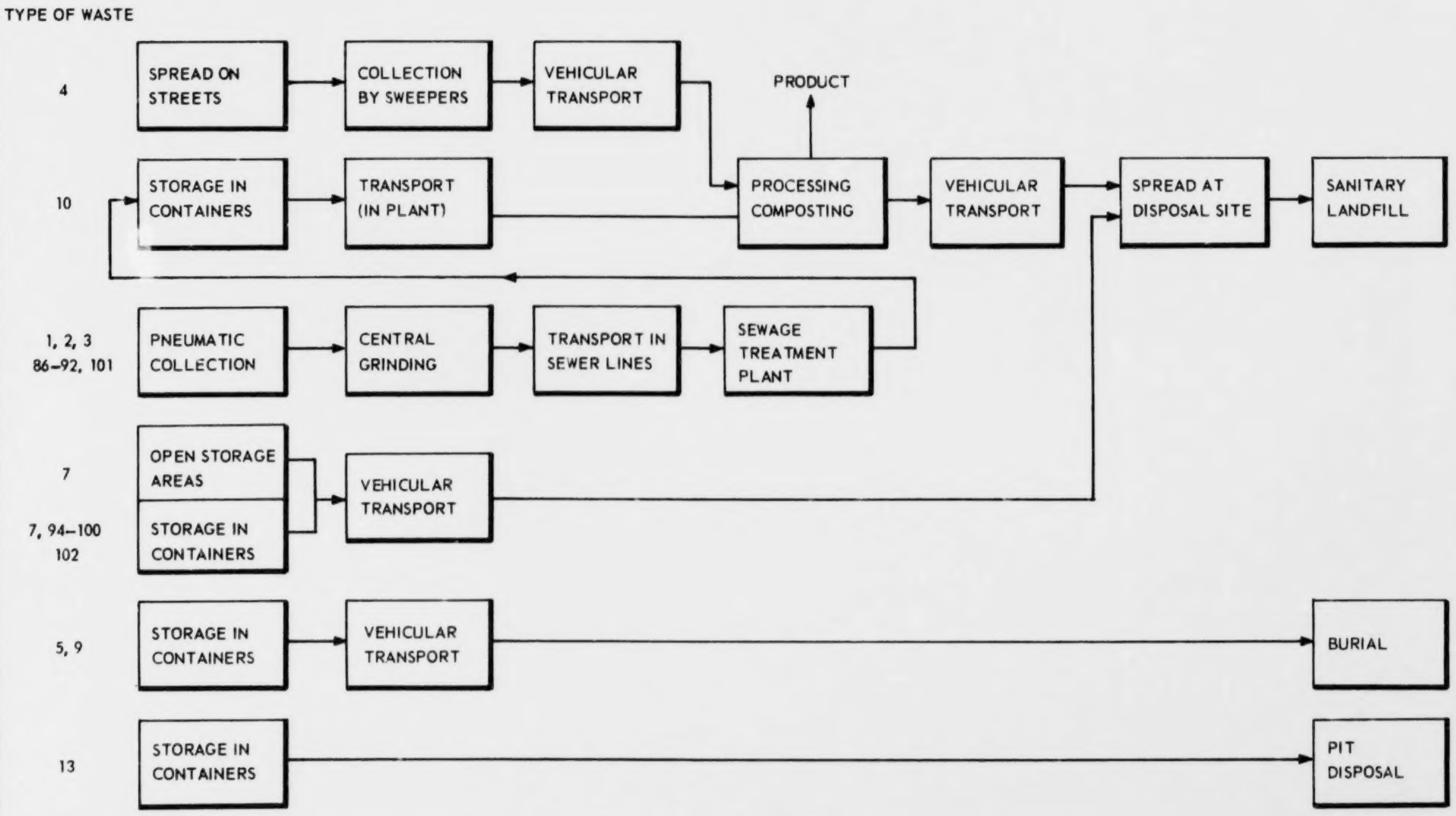
(f) Composting of the increased amount of sludge (10), combined with composting of other biodegradable materials.

(g) Disposal of composting residues and materials that cannot be composted by sanitary landfilling

(h) Dead animals (5) and special wastes (9) buried.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 12


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
PRODUCT
10
STORAGE IN CONTAINERS
TRANSPORT (IN PLANT)
PROCESSING COMPOSTING
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
1, 2, 3
86–92, 101
PNEUMATIC COLLECTION
CENTRAL GRINDING
TRANSPORT IN SEWER LINES
SEWAGE TREATMENT PLANT
7
OPEN STORAGE AREAS
7, 94–100
102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
5, 9
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
BURIAL
13
STORAGE IN CONTAINERS
PIT DISPOSAL

m. System No. 13

This system is characterized by the simplification of storage-collection and by the elimination of vehicular transportation. The wastes would be stored in special underground vaults at the source. The service trucks would collect the wastes by vacuum and be equipped with grinders. The ground wastes would be discharged into the sewerage system at the most convenient manhole. It would be necessary to modify the sewage treatment plant(s) for the increased solids load. Sewage treatment sludge would be disposed of by sanitary landfilling.

(1) Characteristics

(a) Wastes stored in special underground vaults.

(b) Automated pick up and grinding of wastes stored in special containers.

(c) Conventional storage and collection of bulky wastes that cannot be vacuum collected and ground.

(d) Sewage treatment processes for wastes that are transported in sewer lines.

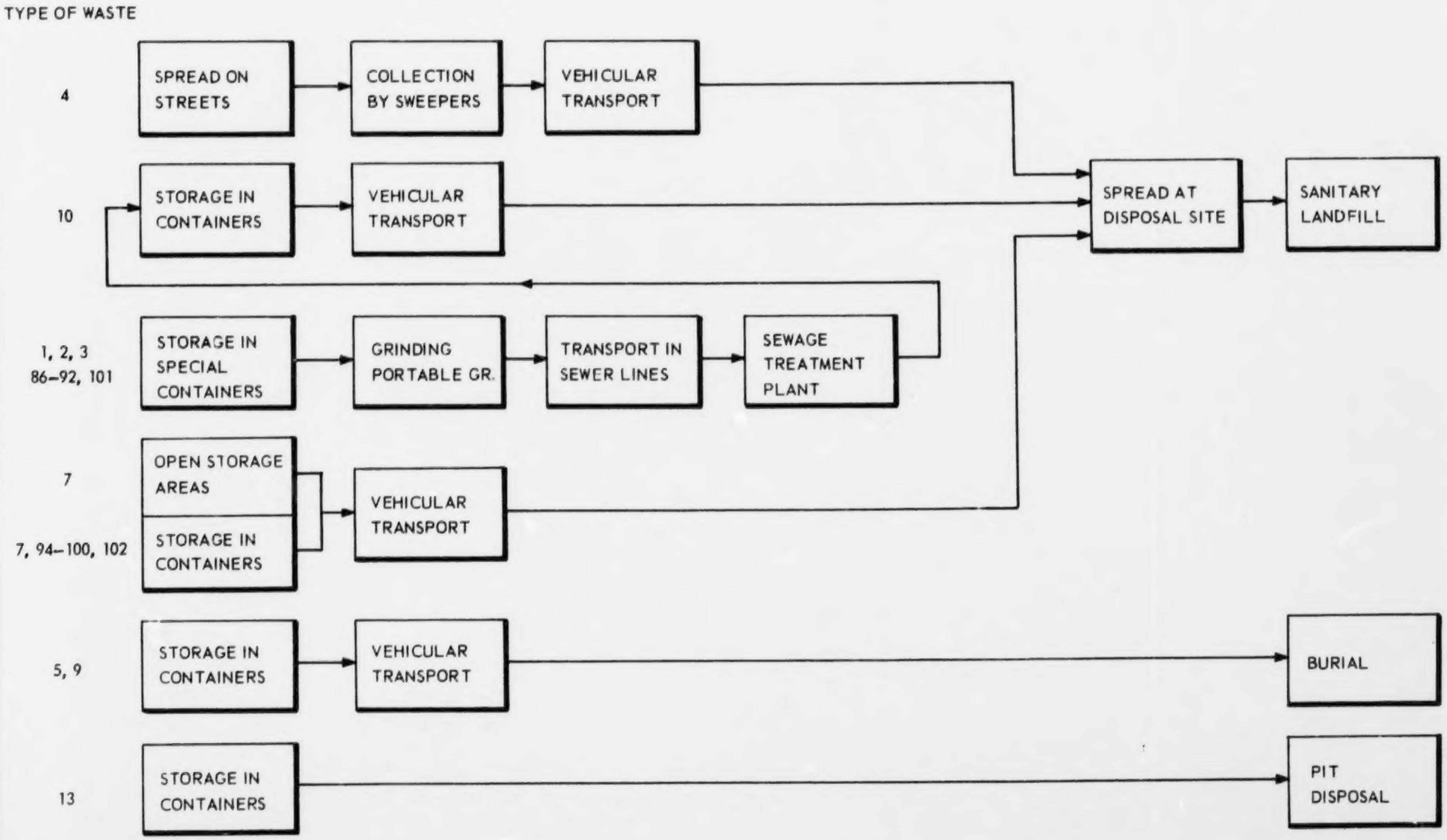
(e) Processing limited to such operations as grinding by trucks and optimizing disposal capacities.

(f) Disposal of conventionally collected wastes by sanitary landfilling.

(g) Dead animals (5) and special wastes (9) buried.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 13


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
10
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
1, 2, 3
86–92, 101
STORAGE IN SPECIAL CONTAINERS
GRINDING PORTABLE GR.
TRANSPORT IN SEWER LINES
SEWAGE TREATMENT PLANT
7
OPEN STORAGE AREAS
7, 94–100, 102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
5, 9
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
BURIAL
13
STORAGE IN CONTAINERS
PIT DISPOSAL

n. System No. 14

This system is identical to System No. 13, with regard to storage, collection, transportation, and processing through the sewage treatment plant. Rather than disposing of all residue by sanitary landfilling, the sewage treatment plant sludge would be incinerated; the incineration plant and the sewage treatment plant will be integrated into a single operation. Incineration residue (ashes) would be disposed of by sanitary landfilling.

(1) Characteristics

(a) Wastes stored in special underground vaults.

(b) Automated pick up and grinding of wastes stored in special containers.

(c) Conventional storage and collection of wastes that cannot be vacuum collected and ground.

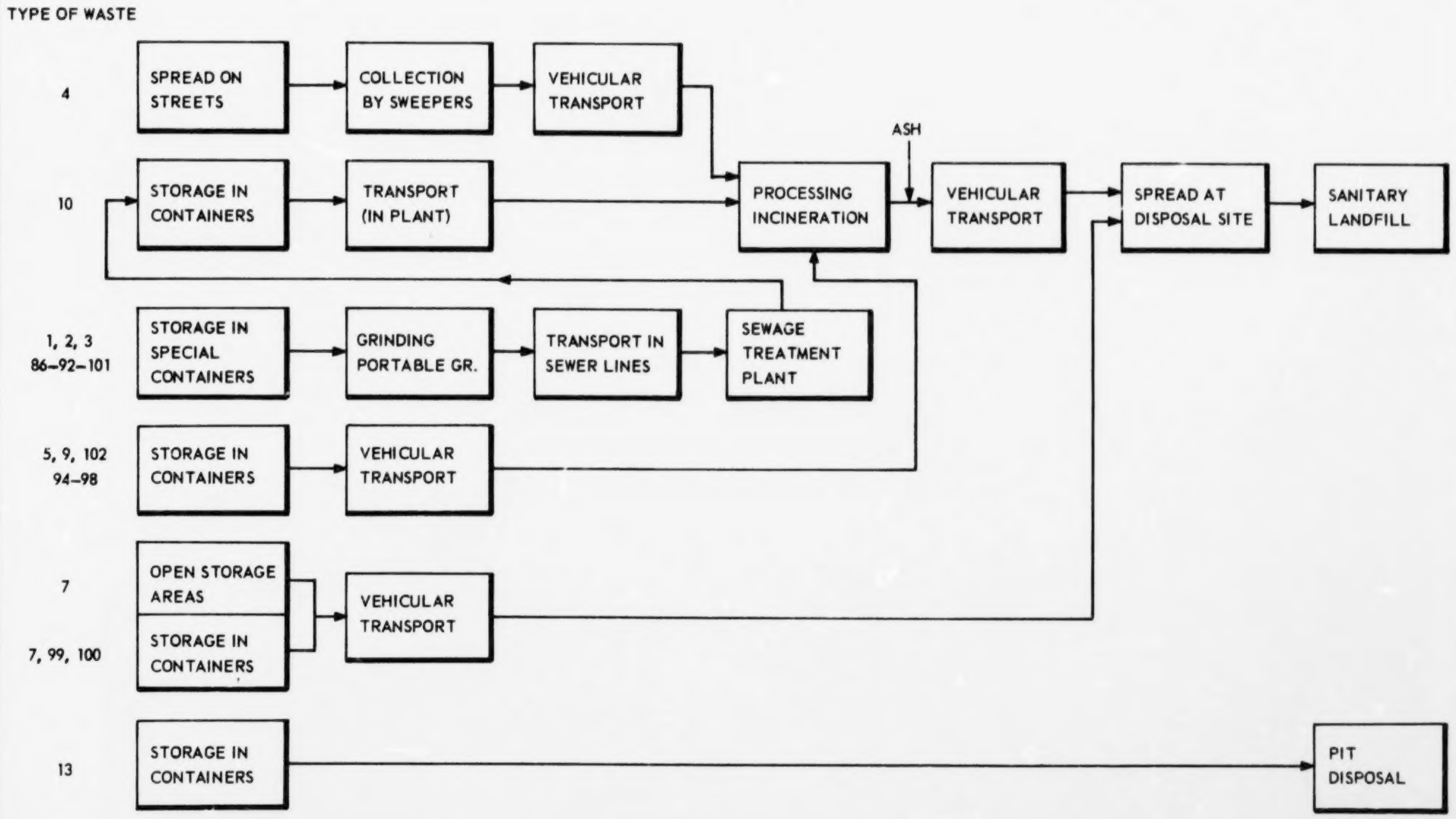
(d) Sewage treatment processes for wastes that are transported in sewer lines.

(e) Incineration of the increased amount of sludge (10), combined with incineration of other combustible wastes.

(f) Disposal of noncombustible wastes and incineration residues by sanitary landfilling.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 14


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
10
STORAGE IN CONTAINERS
TRANSPORT (IN PLANT)
PROCESSING INCINERATION
ASH
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
1, 2, 3
86–92–101
STORAGE IN SPECIAL CONTAINERS
GRINDING PORTABLE GR.
TRANSPORT IN SEWER LINES
SEWAGE TREATMENT PLANT
5, 9, 102
94–98
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
7
OPEN STORAGE AREAS
7, 99, 100
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
13
STORAGE IN CONTAINERS
PIT DISPOSAL

o. System No. 15

This system is identical to System No. 14, except that sewage treatment plant sludge would be composted; the composting plant and the sewage treatment plant would be integrated into a single unit.

(1) Characteristics

(a) Wastes stored in special underground vaults.

(b) Automated pick up and grinding of wastes stored in special containers.

(c) Conventional storage and collection of wastes that cannot be vacuum collected and ground.

(d) Sewage treatment processes for wastes that are transported in sewer lines.

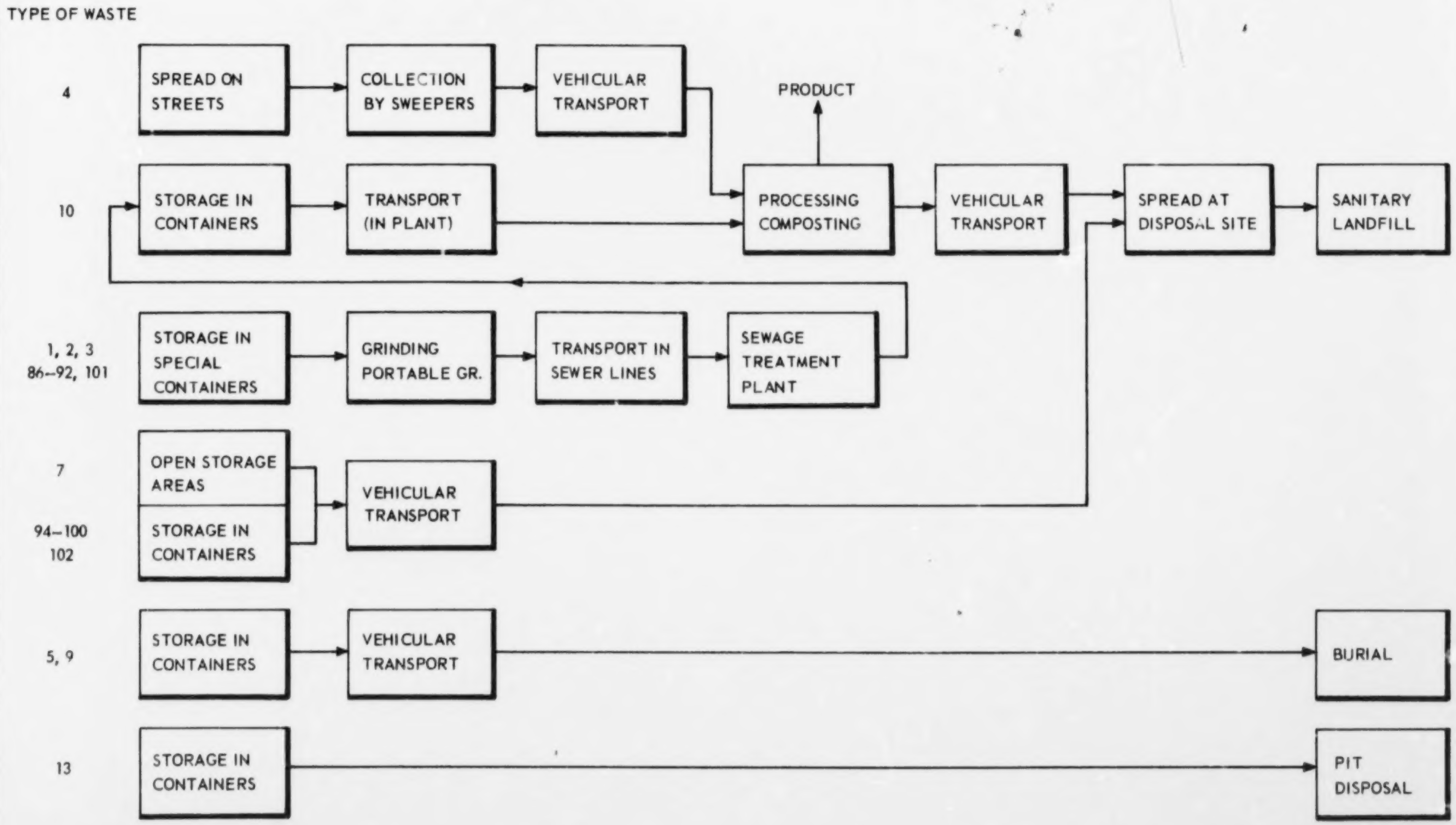
(e) Composting of the increased amount of sludge (10), combined with composting of other biodegradable materials.

(f) Disposal of composting residues and wastes that cannot be composted by sanitary landfilling.

(g) Dead animals (5) and special wastes (9) buried.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 15


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
PRODUCT
10
STORAGE IN CONTAINERS
TRANSPORT (IN PLANT)
PROCESSING COMPOSTING
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
1, 2, 3
86–92, 101
STORAGE IN SPECIAL CONTAINERS
GRINDING PORTABLE GR.
TRANSPORT IN SEWER LINES
SEWAGE TREATMENT PLANT
7
OPEN STORAGE AREAS
94–100
102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
5, 9
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
BURIAL
13
STORAGE IN CONTAINERS
PIT DISPOSAL

p. System No. 16

This system is also characterized by the elimination of storage and manual collection. Domestic and some industrial wastes would be aggregated by pneumatic systems. The aggregated wastes would then be ground at centralized grinding stations. The station would serve a maximum number of waste producers. Ground wastes would be discharged into drop-body containers and transported to sanitary landfills.

(1) Characteristics

(a) Elimination of storage and manual collection.

(b) Wastes collected by a pneumatic system and ground at centralized grinding stations.

(c) Conventional storage and collection of wastes that cannot be collected pneumatically.

(d) Vehicular transport of ground wastes.

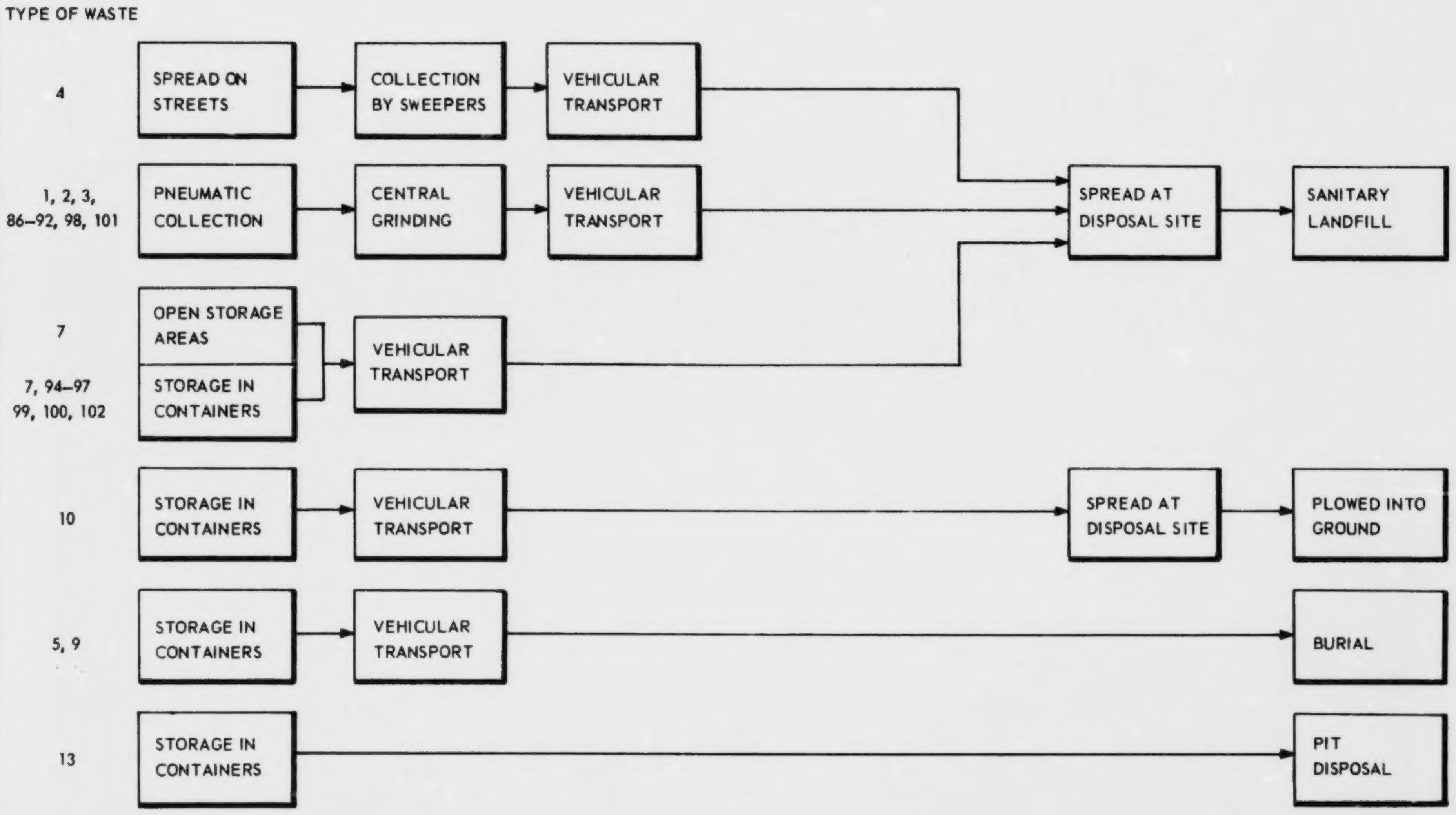
(e) Disposal of most wastes by sanitary landfilling.

(f) Dead animals (5) and special wastes (9) buried.

(g) Sewage treatment residues (10) managed by plowing into the ground.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 16


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
1, 2, 3, 86–92, 98, 101
PNEUMATIC COLLECTION
CENTRAL GRINDING
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
7
OPEN STORAGE AREAS
7, 94–97 99, 100, 102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
10
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
PLOWED INTO GROUND
5, 9
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
BURIAL
13
STORAGE IN CONTAINERS
PIT DISPOSAL

q. System No. 17

This system is identical to System No. 16 as to storage, collection, and transportation. Instead of disposal for all wastes by sanitary landfilling, combustible wastes would be incinerated. The incineration plant(s) would be optimized with regard to performance and the location of the plant(s) would be determined optimizing use of transportation facilities. Non-incinerable wastes, noncombustible wastes, and incineration residue would be disposed of by sanitary landfilling.

(1) Characteristics

(a) Elimination of storage and manual collection.

(b) Wastes collected by a pneumatic system and ground at centralized grinding stations.

(c) Conventional storage and collection of wastes that cannot be collected pneumatically.

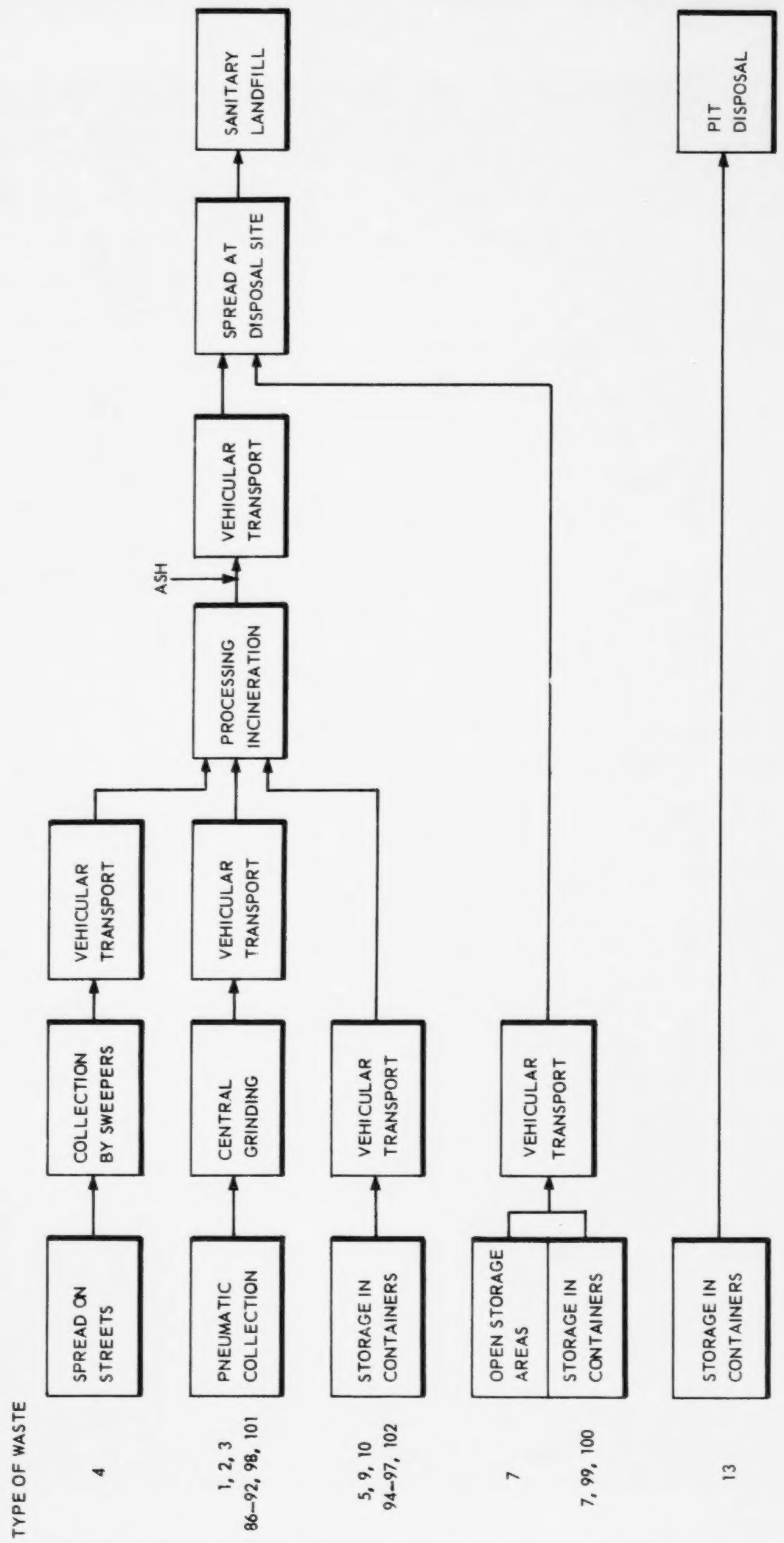
(d) Vehicular transport of ground wastes.

(e) Incineration of all combustible wastes.

(f) Disposal of noncombustible wastes and incineration residues by sanitary landfilling.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 17


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
1, 2, 3
86–92, 98, 101
PNEUMATIC COLLECTION
CENTRAL GRINDING
VEHICULAR TRANSPORT
5, 9, 10
94–97, 102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
PROCESSING INCINERATION
ASH
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
7
OPEN STORAGE AREAS
7, 99, 100
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
13
STORAGE IN CONTAINERS
PIT DISPOSAL

r. System No. 18

This system is identical to System No. 17, except that bio-degradable wastes would be composted. The composting plant(s) would be optimized with regard to performance and the location of the plant(s) would be determined by optimized use of transportation facilities. Non-biodegradable materials, separated at the composting facility, would be disposed of by sanitary landfilling.

(1) Characteristics

(a) Elimination of storage and manual collection.

(b) Wastes collected by a pneumatic system and ground at centralized grinding stations.

(c) Conventional storage and collection of wastes that cannot be collected pneumatically.

(d) Vehicular transport of ground wastes.

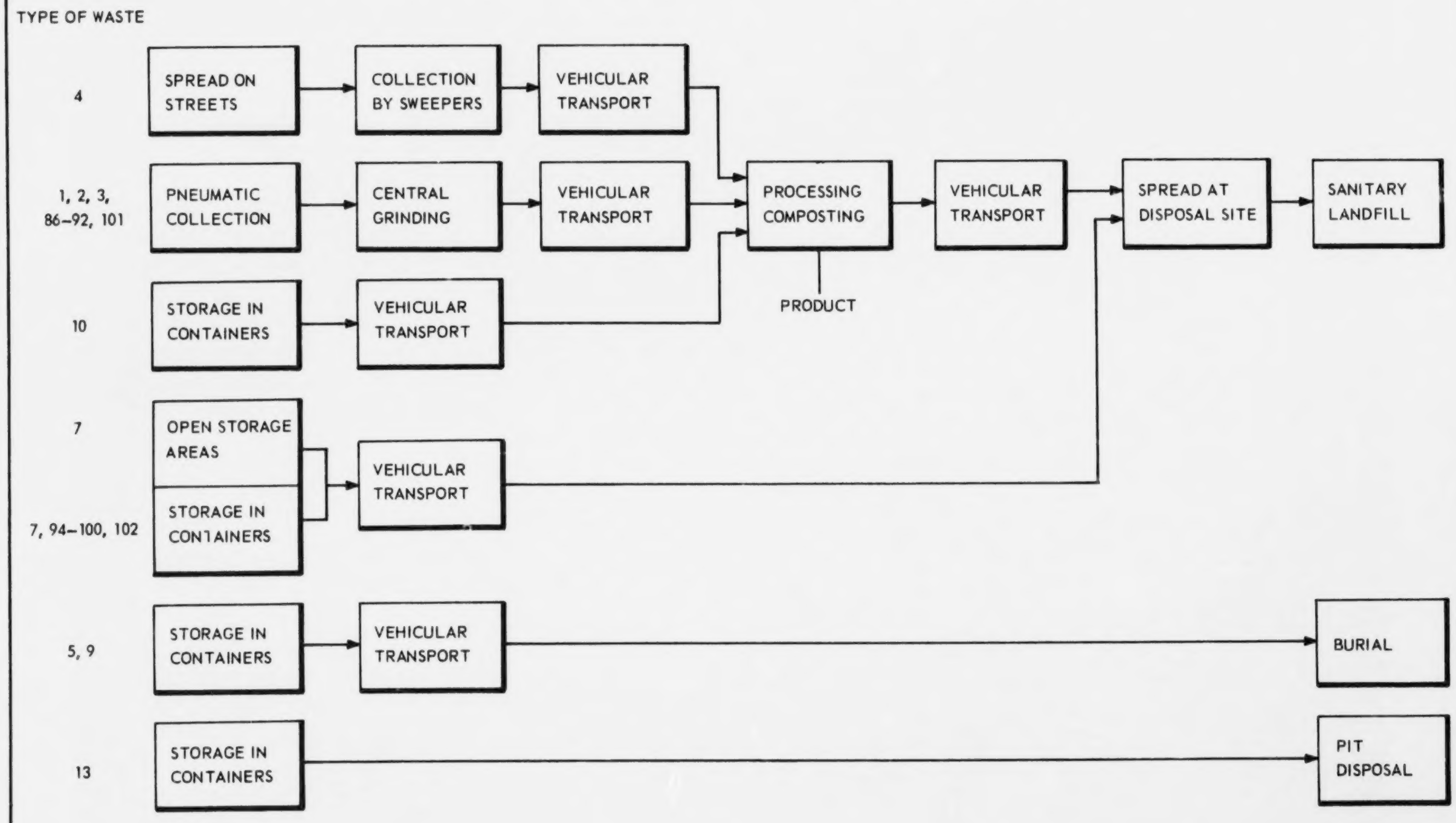
(e) Composting of bio-degradable materials. Compost leaves the waste stream at this point.

(f) Disposal of composting residues and materials that cannot be composted by sanitary landfilling.

(g) Dead animals (5) and special wastes (9) buried.

MANAGEMENT OF MUNICIPAL AND INDUSTRIAL SOLID WASTES

SYSTEM NO. 18


TYPE OF WASTE
4
SPREAD ON STREETS
COLLECTION BY SWEEPERS
VEHICULAR TRANSPORT
1, 2, 3, 86–92, 101
PNEUMATIC COLLECTION
CENTRAL GRINDING
VEHICULAR TRANSPORT
PROCESSING COMPOSTING
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
PRODUCT
10
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
7
OPEN STORAGE AREAS
7, 94–100, 102
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
5, 9
STORAGE IN CONTAINERS
VEHICULAR TRANSPORT
BURIAL
13
STORAGE IN CONTAINERS
PIT DISPOSAL

s. Existing System

The existing system is characterized by large amounts of both municipal and industrial wastes stored in open containers, transported in open vehicles, and disposed of by open burning and open dumping. These "open" methods constitute the major share of environmental pollution due to solid wastes handling in the study region. The approximate percentage for each functional method of handling are shown graphically by Figures VII-1 and VII-2.

The existing system performance score and cost are used as the base for comparing all postulated systems. Section VIII provides this comparison.

Fig. VII-1

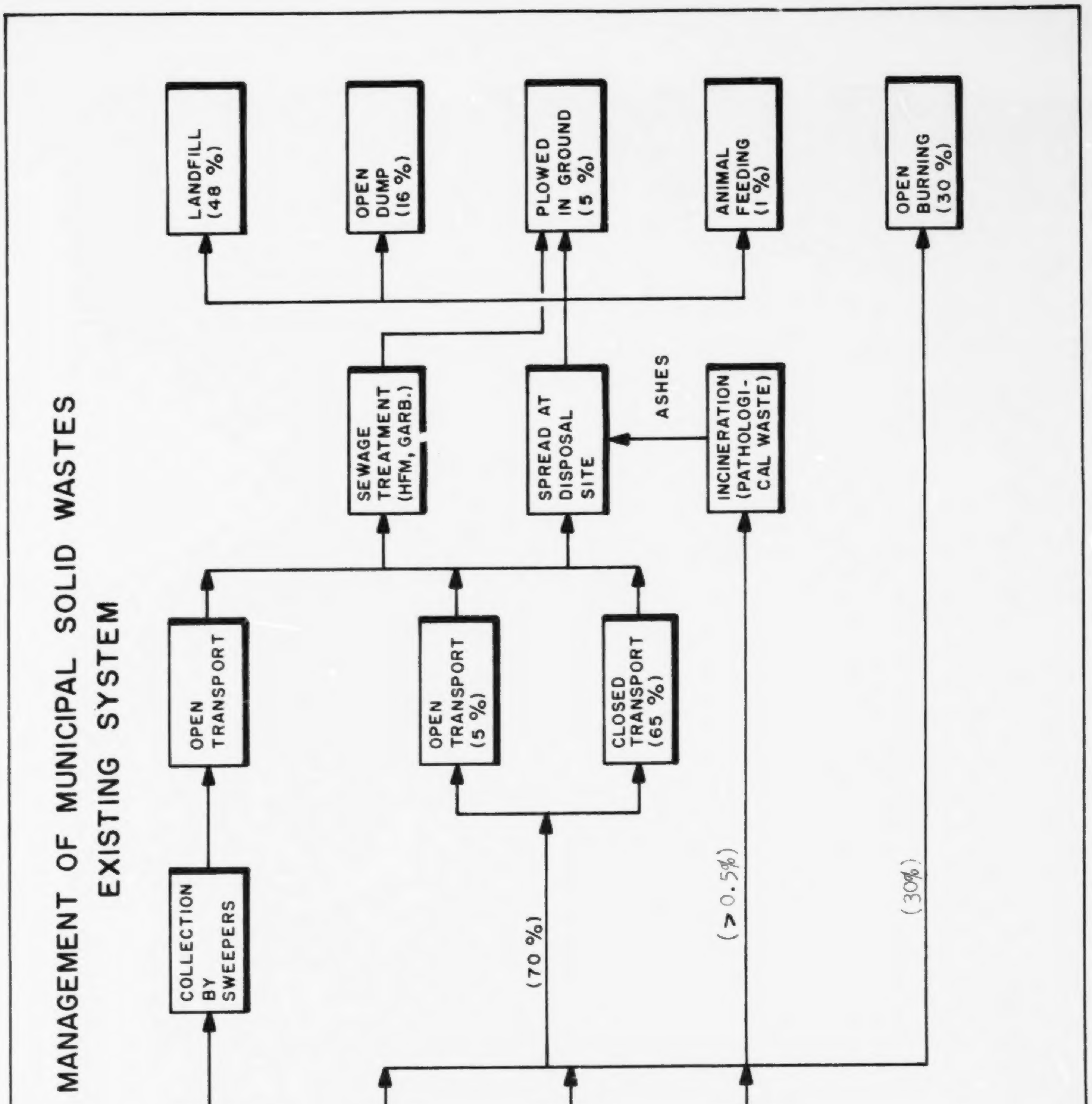
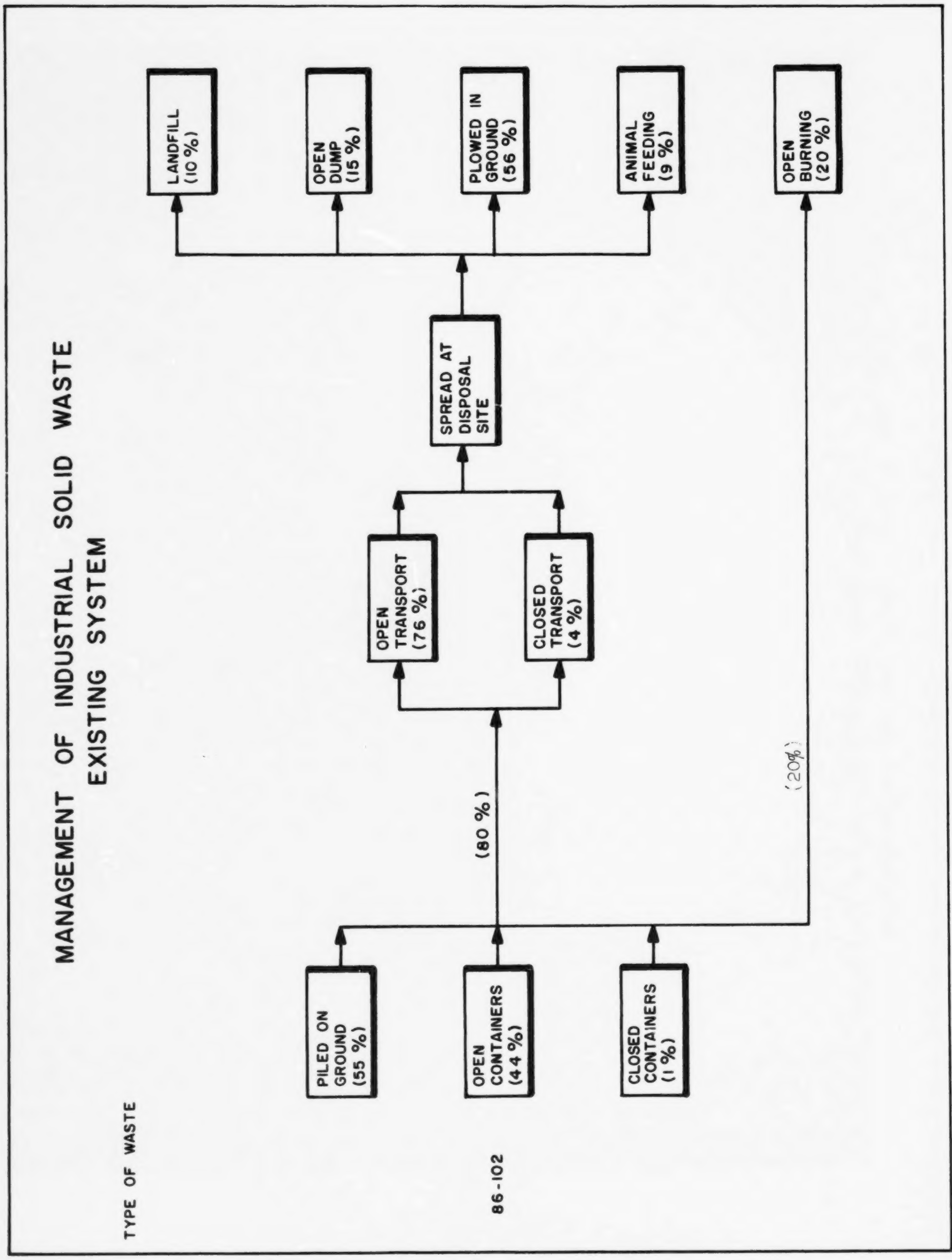

MANAGEMENT OF MUNICIPAL SOLID WASTES
EXISTING SYSTEM
TYPE OF WASTE
4
1,2,3,5-12
SPREAD ON STREETS
PILED ON GROUND (7 %)
OPEN CONTAINERS (44 %)
CLOSED CONTAINERS (49 %)
COLLECTION BY SWEEPERS
(70 %)
(> 0.5%)
(30%)
OPEN TRANSPORT
OPEN TRANSPORT (5 %)
CLOSED TRANSPORT (65 %)
SEWAGE TREATMENT (HFM, GARB.)
SPREAD AT DISPOSAL SITE
INCINERATION (PATHOLOGICAL WASTE)
ASHES
LANDFILL (48 %)
OPEN DUMP (16 %)
PLOWED IN GROUND (5 %)
ANIMAL FEEDING (1 %)
OPEN BURNING (30 %)

Fig. VII-2



MANAGEMENT OF INDUSTRIAL SOLID WASTE EXISTING SYSTEM

TYPE OF WASTE
86-102
PILED ON GROUND (55 %)
OPEN CONTAINERS (44 %)
CLOSED CONTAINERS (1 %)
(80 %)
(20%)
OPEN TRANSPORT (76 %)
CLOSED TRANSPORT (4 %)
SPREAD AT DISPOSAL SITE
LANDFILL (10 %)
OPEN DUMP (15 %)
PLOWED IN GROUND (56 %)
ANIMAL FEEDING (9 %)
OPEN BURNING (20 %)

C. MANAGEMENT OF AGRICULTURAL WASTES

1. Discussion

With agricultural wastes representing a significant fraction of the total wastes, it is justified to consider these wastes as a separate group. These wastes are characterized by their uniformity, seasonal generation, and by their dispersed generation. The major functions (storage, collection and transportation, processing, and disposal) are also applicable for management of agricultural wastes.

a. Storage

Most of the crop residues are stored by spreading in open areas, which provides an elementary, inexpensive method of refuse storage. The storage area frequently becomes the disposal site when wastes are not removed or when they are plowed into the ground.

Storage in containers may be necessary for wastes that are particularly putrescible or when subsequent transportation dictates a type of storage facility. The appropriate variables have been selected as follows:

(1) Storage in open areas.

(2) Storage in closed containers.

b. Collection and Transportation

Although different alternatives (such as transportation in the air or pneumatic systems) could be mentioned, it is unrealistic to assume transportation systems (if any) other than motor vehicles for the next 30 years. The parameters for this operation are, therefore:

(1) Closed vehicular transport

(2) No transportation

c. Processing

Incineration and conversion are the two processes that seem meaningful for an agricultural waste management system. Conversion could include composting or processing to produce animal feeds or other byproducts. Incineration plants and not open burning are recommended. Open burning is strictly excluded in all waste management concepts because of its air pollution effects. It seems relevant to quote some of the statements made in Appendix A, Volume II, of this study:

> "A University of California report on county burning surveys for 1959 through 1961 indicates that agricultural fires are often visible to California residents and contribute to lack of visibility. It states, Agriculture may be blamed at times as the main contributor to general conditions causing air pollution. According to the report, more than 696,000 tons of grain stubble were burned in 1960 in Fresno County as well as more than 70,000 tons of orchard brush. The band of pollution creating plant damage in Fresno County is roughly cigar-shaped, at its maximum about 15 miles wide, extending from Visalia in the south to Chowchilla in Madera County to the north, and roughly parallels U.S. Highway 99. It virtually covers the entire northeasterly half of the Fresno study region."

The most appropriate parameters for processing of agricultural wastes have been selected as follows:

(1) No processing

(2) Incineration

(3) Composting

d. Disposal

As with municipal and industrial wastes, disposal on land seems to be the most reasonable method for agricultural wastes.

e. Summary

The elements of concepts that have been developed and the possible combinations are shown in Table VII-3. Although 12 concepts are possible, only four can be evaluated as practical, namely: (1) storage in open areas - plowed into the ground, (2) storage in containers - transport to sanitary landfill, (3) storage in containers - transport to incineration plant - ash disposal, and (4) storage in containers - transport to composting plants - disposal of composting residues.

Table VII-3

COMBINATION OF CONCEPT PARAMETERS
AGRICULTURAL

Storage	Collection	Processing	Disposal
Open Storage	None		
Storage in Containers	Vehicular	None	
			On land
		Incineration	
		Composting	

2. Systems Descriptions

Agricultural waste management systems are presented in the same general format as the municipal and industrial waste management systems. Four alternative systems are delineated.

In normal agricultural practice residual materials such as stalks and husks are dropped in the field or remain in place during and after the harvest. The common practice is to plow these materials into the ground where they decompose and return trace elements to the soil. The greatest drawback to this procedure is caused by the demand for nitrogen exerted during the initial stages of decomposition by this high carbon content material being broken down. Under such conditions, biological denitrification occurs and, hence, the fertilizer (nitrogen) demand is significantly increased; this is the principal reason that fields are burned before reseeding. Unfortunately, the performance scoring procedure provides sufficient evidence that open burning of these wastes is more detrimental to the overall environment. Should the choice be between only these two, then plowing into the ground must be recommended.

If the wastes are gathered and transported to a centralized site for processing and disposal, the processes which will most likely be employed are central incineration (to control air pollution) or conversion to produce a good soil conditioner or animal feed. If the materials are collected and processed, production of animal feeds has an excellent potential.

As in other solid waste management systems, final disposal will be to the soil either by plowing into the ground or by sanitary landfilling. The agricultural waste management systems may be integrated into the municipal-industrial waste management schemes or remain as independent systems, depending to a large extent on factors of quality control and engineering technical limitations.

a. System No. 1

This system is characterized by its simplicity; it involves the least control. Agricultural wastes simply remain where they are generated. These wastes would be plowed into the ground for natural biological decomposition.

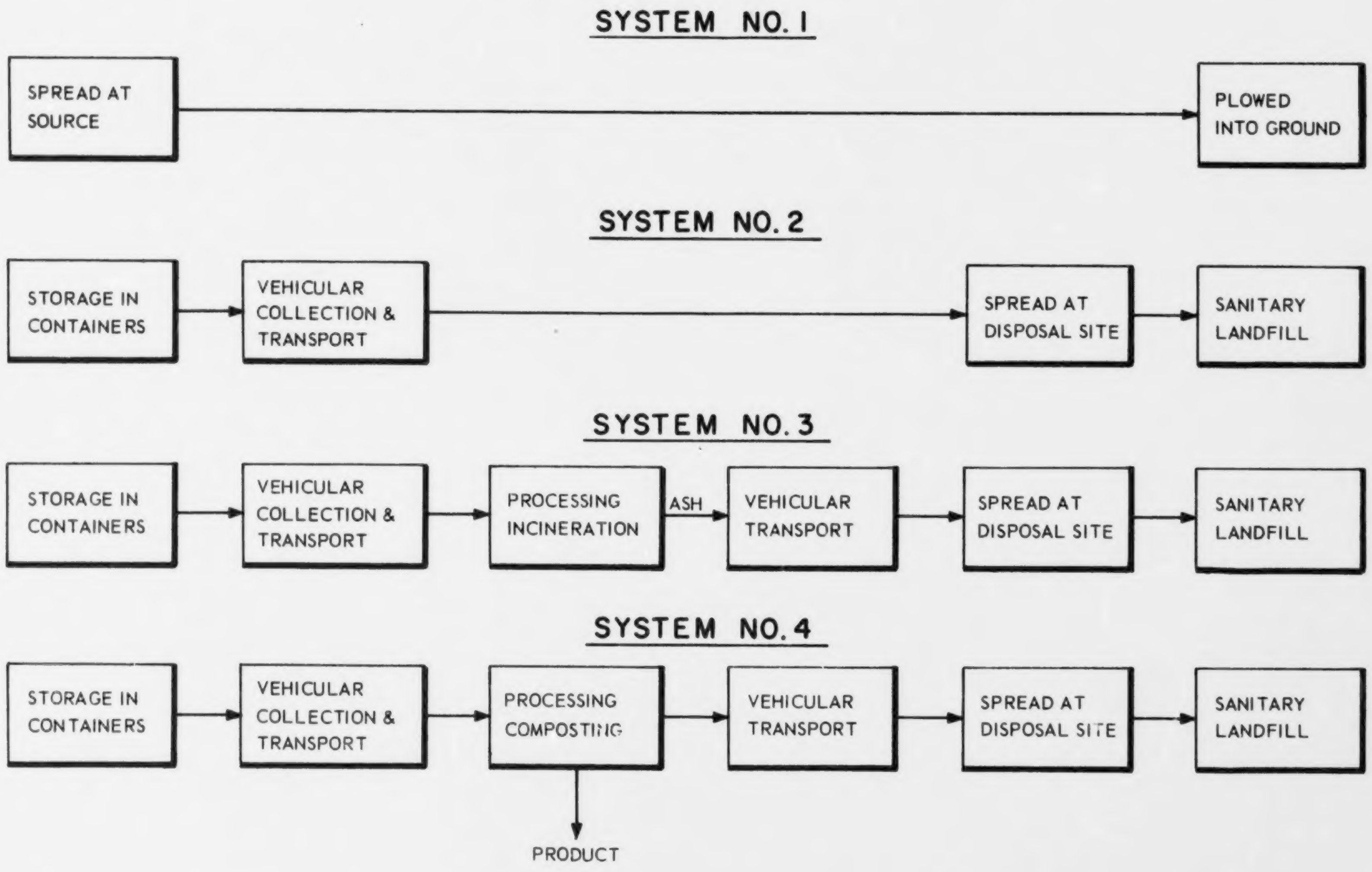
b. System No. 2

This system is characterized by wastes being removed from the fields. The collected wastes would then be transported by vehicles to a disposal site. Final disposal would be by sanitary landfilling.

c. System No. 3

This system is characterized by wastes being removed from their point of generation to an incinerator. Incineration of some agricultural wastes could be combined with municipal incineration. The ashes would be disposed of by sanitary landfilling.

MANAGEMENT OF AGRICULTURAL SOLID WASTES


SYSTEM NO. 1
SPREAD AT SOURCE
PLOWED INTO GROUND
SYSTEM NO. 2
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
SYSTEM NO. 3
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
PROCESSING INCINERATION
ASH
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL
SYSTEM NO. 4
STORAGE IN CONTAINERS
VEHICULAR COLLECTION & TRANSPORT
PROCESSING COMPOSTING
PRODUCT
VEHICULAR TRANSPORT
SPREAD AT DISPOSAL SITE
SANITARY LANDFILL

d. System No. 4

This system is characterized by wastes being removed from their point of generation and hauled away for organized composting. Residues from the process would be disposed of by sanitary landfilling.

e. Existing System

The existing system, in general, is shown by Figure VII-3. Both crop residues and manures produce gross environmental effects due particularly to the long periods of storage. The open transport of manures (50%) also produces a large effect for the transient portion of the existing system. The final disposal by open burning of 30% of the region's crop residues also contributes significantly to environmental effects (air pollution). Animal feeding of crop residues, while economically acceptable, provides ample opportunity for fly breeding and can also contribute to animal disease from pesticide residuals.

The current practice of range feeding for the sheep population leaves little possibility for improvement with respect to environmental effects since this practice is not expected to change.

D. TRENDS IN SOLID WASTE MANAGEMENT

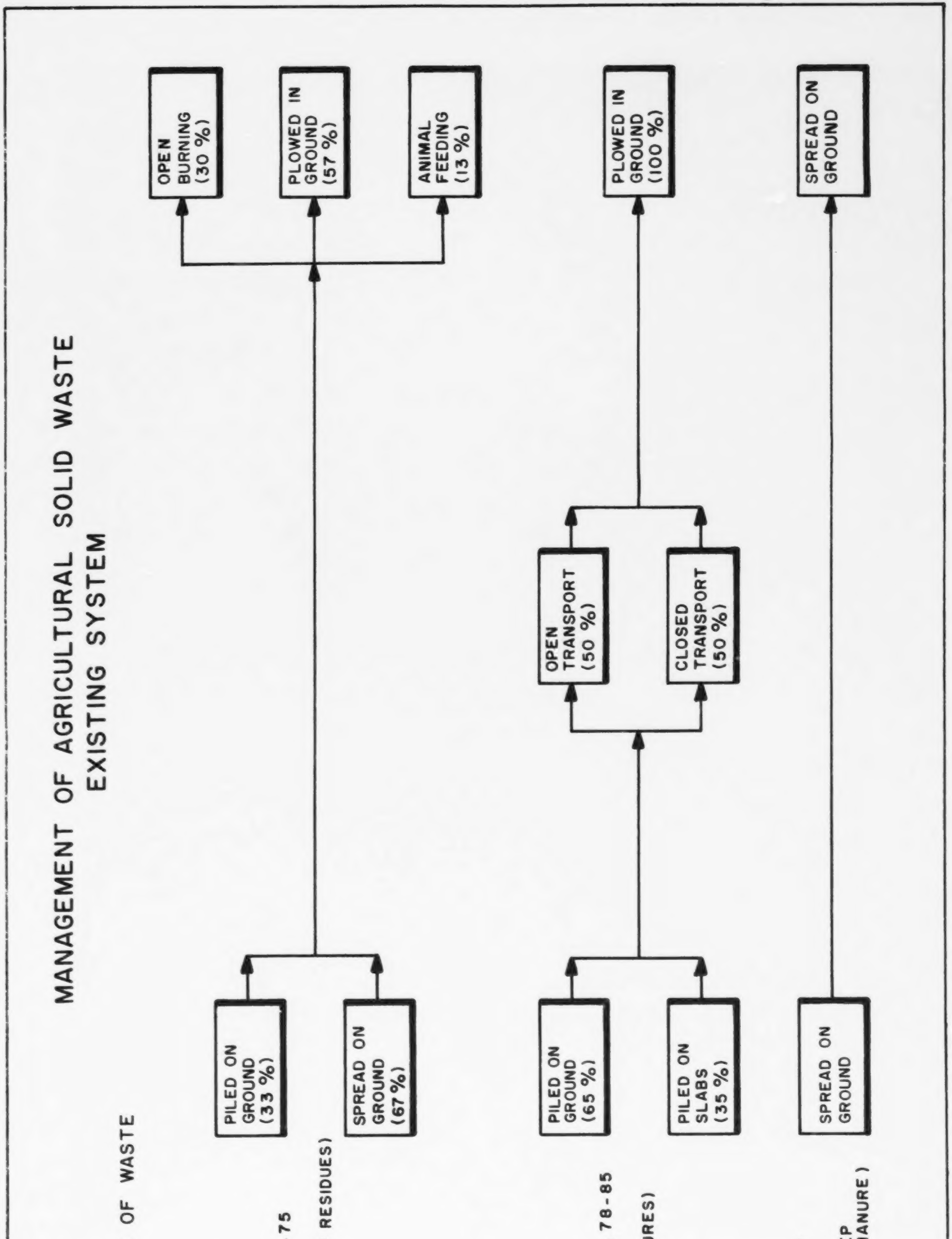
Research and development projects for solid waste management are currently involved in improvement of existing technology and the development of new processes and systems. These areas were discussed in detail in Appendix B and C, Volume II, of the Interim Report, with the more pertinent trends summarized herein.

1. Improvement of Existing Technology

Limitations of existing management systems occur in storage, collection and transportation, and final disposition of solid wastes.

Storage of solid wastes at the point of generation, regardless of method, represents a nuisance that most householders would be willing to pay

Figure VII-3



MANAGEMENT OF AGRICULTURAL SOLID WASTE
EXISTING SYSTEM

TYPE OF WASTE
16-75
(CROP RESIDUES)
PILED ON GROUND (33 %)
SPREAD ON GROUND (67 %)
OPEN BURNING (30 %)
PLOWED IN GROUND (57 %)
ANIMAL FEEDING (13 %)
76, 78-85
(MANURES)
PILED ON GROUND (65 %)
PILED ON SLABS (35 %)
OPEN TRANSPORT (50 %)
CLOSED TRANSPORT (50 %)
PLOWED IN GROUND (100 %)
77
(SHEEP MANURE)
SPREAD ON GROUND
SPREAD ON GROUND

for to eliminate. This has been clearly demonstrated by the rapid upsurge in the use of household garbage disposal units.

Noise, traffic interference, and esthetic problems associated with cleanliness of equipment are still present in current collection and transportation technology.

Processing of solid wastes creates little apparent problem outside of incineration where stack emissions require expensive equipment for prevention of air pollution problems or when the particular process involved is inadequately operated.

Solid waste disposal is accomplished primarily by sanitary landfilling. Competent methodology for landfill operations is rarely practiced, resulting in operations being little better than open dumps. However, with proper planning, design, and operation, landfilling can be improved to a satisfactory and esthetically acceptable level.

2. Development of New Processes and Systems

New concepts for source storage of solid wastes include containers designed for automated pick up of the wastes. Automated collection can be reasonably expected to advance to a degree where individual storage of wastes will be eliminated by immediate collection at the source. It can also be expected that research and development efforts will proceed along lines that will perfect the technologies of grinding and separation to permit inclusion of ordinary solid wastes into the existing sewer systems.

Already practiced in Europe, incineration in the U.S. will probably be considered as much a power generation process as a waste disposal process. The heat can be recovered for use by industry or other community uses.

Perfection of processes such as wet oxidation, pyrolysis, and composting will not only provide for disposal of wastes but also convert them into new marketable products such as organic acids, alcohols, tars, and soil conditioners. These, or similar methods, are more acceptable to the conservation aims of our society. This report has chosen a very conservative approach to the potentials for salvage; new technologies for the recovery of food wastes for animal feed or for the production of by-products, such as alcohols, will require re-evaluation and recognition of such changes.

VIII. SCORING AND COSTS

A. INTRODUCTION

In the preceding section of this report, 18 postulated systems for handling municipal and industrial solid wastes were described, as well as 4 agricultural systems. The scoring procedures developed in this study were applied to all the above systems including the existing system and the results are presented in this section. In addition, the rationale for selecting an optimum system for the Fresno region was developed, using the resulting data on system performance and cost in combination with the predicted regional economic capacity.

B. PERFORMANCE SCORING

The scoring methodology and procedures were described in detail in Section IV. Application of the described technique resulted in transient and disposal (see Section IV) bad effect scores for the existing and eighteen postulated municipal-industrial solid waste management systems as well as scores for the existing and four postulated agricultural systems defined in Section VII.

As previously explained in Section IV, the scores for transient and disposal components of any given system cannot be totaled, since transient scores would tend to be overpowered by the greater magnitude of disposal scores. Using the existing system scores for both transient and disposal components as separate references; it is possible, however, to determine the percent improvement in the reduction of bad effects to each component (transient and disposal) that could be expected by incorporation of each of the conceptualized systems. The percent improvement for each component for each postulated system was then calculated and the results averaged to arrive at overall system improvement percentages. The basis for averaging the transient and disposal component improvement percentages is as stated in Section IV. Table VIII-1 and 2 delineate the performance scoring results for each of the systems postulated.

Table VIII-1

PERFORMANCE IMPROVEMENT AND COSTS

Municipal-Industrial Systems

(Year 2000)

System	Performance Score		% Performance Improvement		Average % Perf. Imp.	Cost (Millions)
	Transient	Disposal	Transient	Disposal		
Existing	36,488	3,114,529	0	0	0	26.9
1	15,989	2,247,393	56	28	42	36.2
2	11,401	966,242	69	69	69	54.7
3	10,185	801,684	72	74	73	49.8
4	9,248	2,536,745	75	19	47	45.6
5	4,607	968,077	88	69	78	64.1
6	3,435	874,818	91	72	82	58.8
7	4,214	2,269,967	88	27	58	50.9
8	3,831	1,585,284	90	49	70	67.8
9	2,277	1,153,194	94	63	78	63.6
10	1,605	1,529,790	95	51	73	122.0
11	2,672	1,586,103	93	49	71	141.2
12	527	885,799	98	74	86	138.4
13	5,589	1,529,331	85	51	68	42.3
14	5,371	1,589,985	85	49	67	61.4
15	3,303	1,343,395	91	57	74	58.9
16	6,721	2,247,382	81	28	60	121.1
17	2,086	966,242	94	69	82	139.1
18	902	874,231	97	72	84	136.0
Selected System	2,020	821,033	94	74	84	48.6

Table VIII-2

PERFORMANCE IMPROVEMENT AND COSTS

Agricultural Systems

(Year 2000)

System	Performance Score		% Performance Improvement		Average % Perf. Imp.	Cost (Millions)
	Transient	Disposal	Transient	Disposal		
Existing	152,953	4,640,474	0	0	0	6.7
1	39,319	3,891,988	74	16	45	6.9
2	55,662	3,308,178	64	29	46	16.9
3	45,560	1,211,728	70	74	72	76.3
4	44,908	609,026	71	87	79	49.9
Selected System	36,759	1,647,006	76	65	70	30.0

C. COSTING

In costing the conceptualized and existing solid waste management system, the basic unit costs used were taken from the data contained in Appendix D, Volume III, of this report. Cost data for advanced concepts incorporating hardware not presently available are based on engineering estimates. Table VIII-3 summarizes the unit costs used.

Total costs for the solid waste management systems (shown in Tables VIII-1 and 2) are based on the above unit costs per ton of the various handling concepts. They represent a summation of the products of unit costs times total tons for each operation included in the system. The total costs shown are for systems postulated for the year 2000 expressed in 1967 value dollars.

D. ANCILLARY EFFECTS SCORING

In addition to calculating the costs and percent reduction in bad effects for each system under consideration the scoring procedures for determining the ancillary effects were also applied. This procedure, described in detail in Section V, relates and scores the environmental effects of the various physical objects and procedures which make up the different solid waste management systems being considered.

These scores can then be used to finalize system selection when a number of competing systems are very close in cost and bad effect reduction effectiveness. The ancillary effects or "A" scores for the systems within the established cost and performance limitations are shown in Table VIII-4.

E. COST-BENEFIT ANALYSIS

1. Systems Evaluation

With the data from the performance scoring and costing, the net percent performance improvement for each conceptualized system was plotted versus its associated total cost. The results are shown on Figure VIII-1 for municipal-industrial solid waste management systems and on Figure VIII-2 for agricultural systems. These plots are referred to as cost-benefit

Table VIII-3

UNIT COSTS

Storage

Candidate Concept	Concept No.*	Collections Per Week	Cost/Ton 1967
Heavy Duty Galvanized Steel Cans	S-3	6	$ 0.55
		2	1.60
		1	3.20
Pre-cast Underground Vaults	S-22	6	0.34
		2	1.00
		1	2.00
		.5	4.00
Large Constructed-in-Place Vaults	S-23	6	0.17
		2	0.50
		1	1.00
		.5	2.00
Open Storage	S-24	1	0.005
		.5	0.010
Drop Body Containers	S-16	6	0.34
		1	2.00
		.5	4.00
Drop Body Compactor Containers	S-18	6	0.54
		1	3.20
		.5	6.40

---

*Appendix D, Volume III

Table VIII-3 (Continued)

UNIT COSTS

Collection

Candidate Concept	Concept No. *	Collections Per Week	Cost/Ton 1967
Rear Loading Compactor Truck; Daily Route Method; Private Property Service; Direct Container Transfer; 2 man crew, 2 loads/day	C-200	6 2 1	$ 19.00 14.50 12.85
Lift and Carry Hoist Truck; Lift Fork Tilt Hoist Type; Daily Route Method Private Property Service; 1 man crew; 4 loads/day (9 ton)	C-8	All	1.75
Side Loading Vacuum Compactor Truck; Daily Route Method; 1 man crew, 2 loads/day	C-118	6 2 1	19.00 14.30 12.70
100-Unit Vacuum Tube Collection System, Evacuated by Mobile Compressor Unit	C-120		54.00
Side Loading Vacuum Grinder Truck; Daily Route Method; 1 man crew; 2 loads/day (Dispose to sewers)	C-122	6 2 1	19.00 14.30 12.70
Open Body Truck; Daily Route Method; Private Property Service; Direct Container Transfer; 2 man crew; 2 loads/day	C-201	6 2 1	18.00 13.10 11.40
Street Sweeping, (8.6 c.y.)	C-121 (C-17)	1	21.80
Side Loading Vacuum Compactor Truck; Daily Route Method; 2 man crew; 2 loads/day	C-118 + S-22 + Conduit	6 2 1	35.80 27.00 24.00

---

*Appendix D, Volume III

Table VIII-3 (Continued)

UNIT COSTS

Transportation
(Average 20 Mile Haul)

Candidate Concept	Concept No.*	Cost/Ton 1967
Rear Loading Compactor Truck; 2 man crew	C-200	$ 5.80
Lift and Carry Hoist Truck; 1 man crew	C-8 (Similar to T-7, combined with S-18)	1.75
Side Loading Vacuum Compactor Truck; 2 man crew	C-118	5.80
Underground Vacuum Tubes (No Collection or Storage)	C-18	46.00
Liquid Transport (Separate System) (No Collection or Storage)	C-20	15.00 (Existing Sewers-negligible cost)
Open Body Truck; 2 man crew	C-201	4.55

---

*Appendix D, Volume III

Table VIII-3 (Continued)

UNIT COSTS

Processing

Candidate Concept	Concept No. *	Cost/Ton 1967
Central Municipal Incineration (Standard)	P-1	$ 7.00
Central Municipal Incineration (With Air Pollution Control)	P-1A	9.00
Sludge Incineration	P-3	24.00
Industrial Incineration	P-4	10.00
Open Burning	P-6	(Negligible)
Composting (Mechanical)	P-9	10.00
Composting (Windrow)	P-9	5.00
Sewage Treatment	P-10	3.00
Single Residence Refuse Grinders	P-12	28.00
Central Refuse Grinders	P-13	3.00
Central Compression and Baling	P-17	4.50

---

*Appendix D, Volume III

Table VIII-3 (Continued)

UNIT COSTS

Disposal

Candidate Concept	Concept No.*	Cost/Ton 1967
Sanitary Landfilling	D-1	$ 1.20
Open Dumping	D-2	0.50
Land Spreading	D-3	1.00
Animal Feeding	D-4	0.17

---

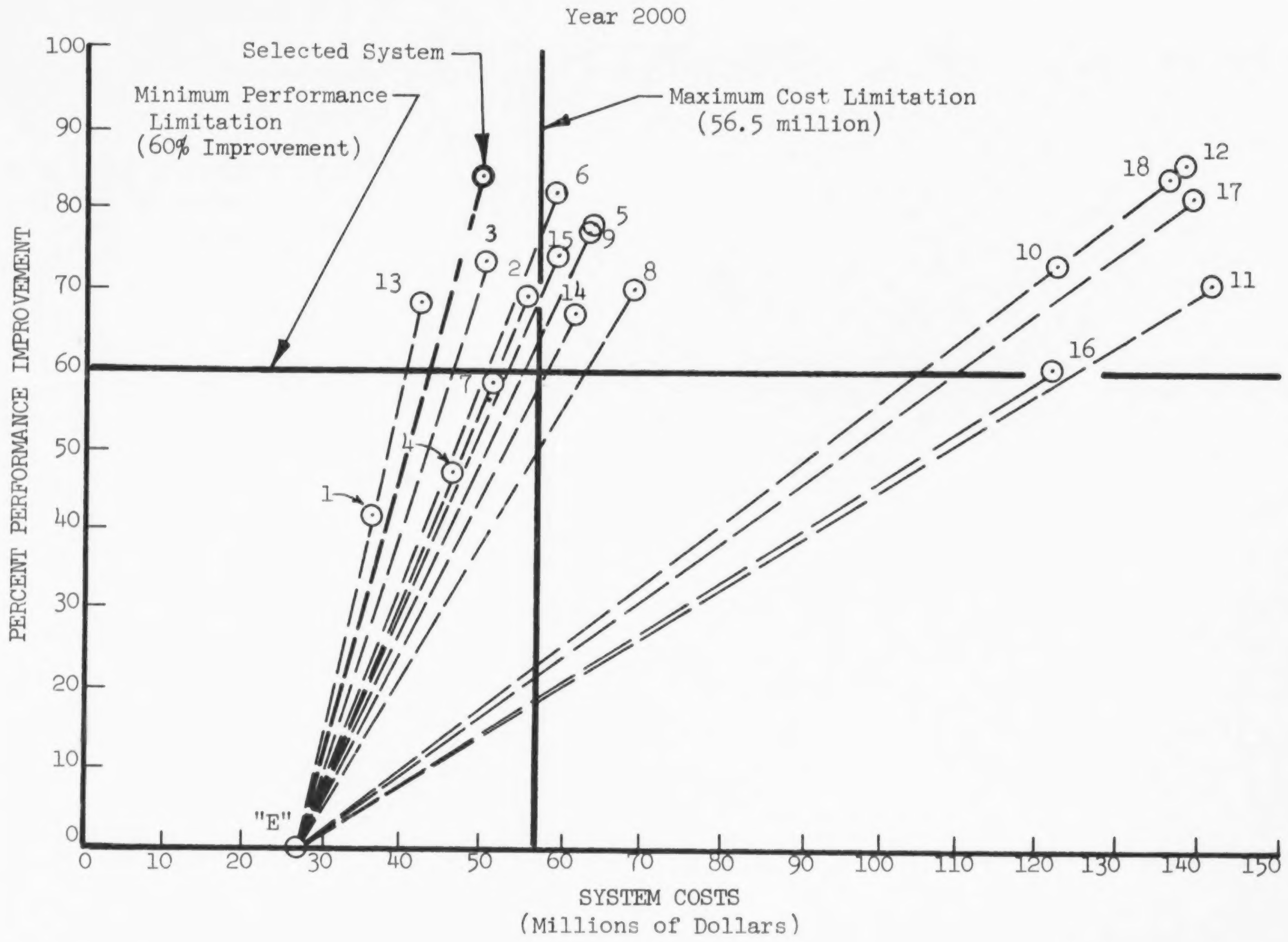
*Appendix D, Volume III

Table VIII-4

ANCILLARY EFFECTS SCORES

System	"A" Score
2	25.39
3	25.59
6	22.12
7	18.42
13	20.81
15	21.42
Selected System	17.24

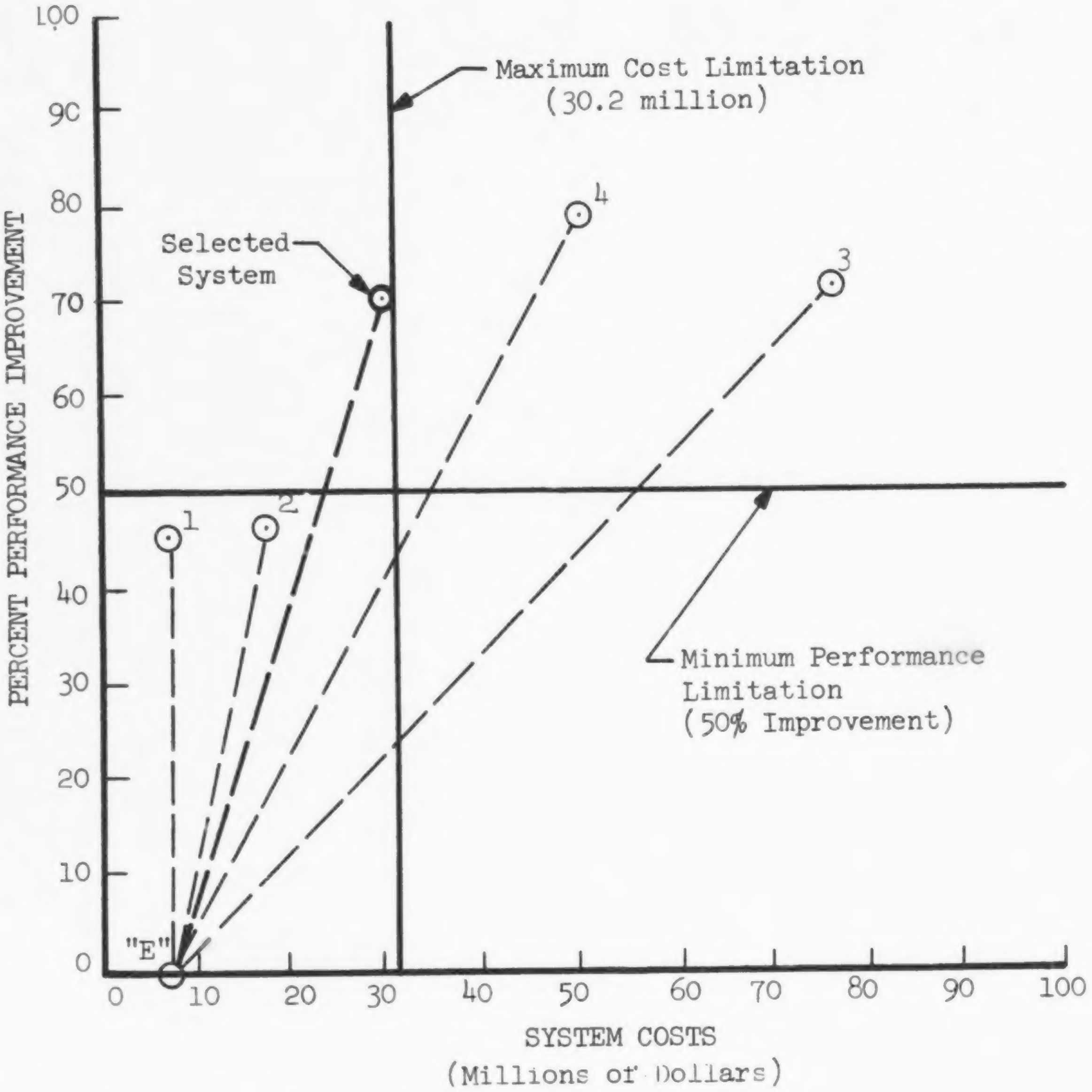
NOTE: Only those systems within established cost and performance limitations were scored.



Note: 1. Pt. "E" represents existing system.
2. Slope from "E" to system designation represents % improvement per million dollars expended.

Figure VIII-1. Cost-Benefit Analysis Municipal - Industrial Systems

Year 2000



Note:
1. Pt. "E" represents existing system.
2. Slope from "E" to system designation represents % improvement per million dollars expended.

Figure VIII-2. Cost-Benefit Analysis Agricultural Systems

analysis since the slope of each connecting line represents the average percent improvement per million dollars expended in excess of existing system costs. The lines do not represent a plot of various expenditures and their associated performance score improvements. The maximum slope (highest cost-benefit ratio) for the postulated municipal-industrial systems is attained by Systems No. 1 and 13. The maximum benefit (reduction of bad effects) is achieved by System No. 12 although at an extremely high cost.

Consultation with state and local Fresno administrative officials resulted in the establishment of performance limitations. The apparent increased expenditures required to provide any significant quantifiable and observable environmental improvements were judged to warrant on the order of a minimum 60 percent increase for the municipal-industrial system in the Fresno region. Anything less (for example 10 to 20 percent increments) could conceivably go unnoticed by the proposed beneficiaries. The limit for agricultural systems, with due consideration given to competitive effects, was lowered to 50 percent, with recognition of the relatively small number of persons affected by adverse effects in the agricultural sector as opposed to the far greater number of persons living in the municipal region.

The existing system of management extrapolated to the year 2000 would cost the region some 33.5 million dollars per year. Of this sum 25.2 million would be required for municipal waste, 1.6 million for industrial, 5.7 million for manures and 1.0 million for crop residue management. All costs indicated above are in terms of 1967 value dollars.

Based on conservative economic projections the real disposable income of the region's population is expected to increase some 42 percent with attendant increases in standards of living. With the resulting higher education levels and increased affluence, the population is expected to demand and be willing to pay for an improved environment. Continuing the existing system to the year 2000 will not only result in no improvement but, rather, a gradual and steady degradation of the environment.

In 1967 the estimated regional expenditure for solid waste management was 10.2 million dollars. This sum amounted to 0.93 percent of the regional income. With the projected increase in per-capita real disposable income in the year 2000, 42 percent more will be available from each individual without any increase in the percentage of income being expended for this purpose. Unfortunately, the per-capita waste generation, especially the municipal portion, is also predicted to increase. This increase almost matches the increase in disposable income in the region and, thus, the 33.5 million dollars projected existing system cost in the year 2000 is still 0.90 percent of the increased regional income.

As previously indicated, the more affluent, better-educated populace of the year 2000 will probably demand an improved environment. A minimum 60 percent improvement should be well worth doubling the income percentage allocated to solid waste management, especially when the per-capita real disposable income will have increased 42 percent. The proposed maximum system cost for municipal waste management in the year 2000 will, thus, be set at twice the projected present system costs, or 50.4 million dollars.

The industrial wastes in the year 2000 are estimated to be approximately 9.1 percent of the projected total regional wastes. Projecting the present system requires an expenditure of only 1.6 million dollars, or only 4.8 percent of the regional cost to handle 9.1 percent of the projected total regional wastes. To eliminate this inequity requires the application of a 90 percent increase in costs allocated to industrial solid waste management. In addition, the 60 percent environmental effects reduction, similar to the municipal situation, should be worth an additional 100 percent cost increase. The proposed limit for system costs for industrial solid waste management in the year 2000 is, therefore, set at 1.9 x 2.0 x 1.6 million, or 6.1 million dollars.

Similarly, the projected present system costs for handling manures which make up 39 percent of the region's solid waste load is 5.7 million dollars, or only 17 percent of the total system costs. To equalize this situation requires an additional 130 percent allocation, while the attainment of a minimum 50 percent environmental improvement will necessitate an additional 100 percent expenditure over and above the equalizing increase. The system cost limit for manures in the year 2000 is, thus, set at 2.3 x 2.0 x 5.7, or 26.2 million dollars.

The limit for management system expenditure for crop residue for the year 2000 will be arbitrarily set here at 4.0 million dollars. This amount is 4 times the projected present system costs. Although the crop residues in the year 2000 will make up 24.4 percent of the regional solid waste, the competitive position of this important regional industry must be also considered as well as the smaller number of persons directly affected by the bad effects. The management of these vast amounts to the same extent as municipal and industrial wastes would require a considerably greater cost. Thus, a lesser environmental effects improvement has been accepted for these wastes, together with a relatively lesser allowable management system cost.

The total solid waste management system limit cost for the year 2000 is thus:

Municipal	50.4 million dollars
Industrial	6.1 million dollars
Manures	26.2 million dollars
Crop Residues	4.0 million dollars
Total	86.7 million dollars

The cost limit for the municipal-industrial system is 56.5 million dollars and that for the agricultural system, including manures, is 30.2 million dollars. These are the cost limits indicated on Figures VIII-1 and 2

Although the constraints within which these cost limits are developed appear generous by today's standards, it is important to note that few people currently recognize the need for and financial requirements of solid waste management. As national recognition of this need increases with time, it is probable that the established cost limits, even when related to existing spending levels, will appear conservative in the light of what people will be willing to spend in the future.

With little consideration given to legal, political, sociological, and practical constraints, i.e., on a purely technical-economical basis, municipal-industrial systems No. 2, 3, and 13 are the only postulated systems that satisfy the established limitations although systems 6, 7, and 15 also should be considered. Similarily, no agricultural system falls within the established cost-benefit limits. The cost-benefit analysis results, especially the fact that none of the postulated agricultural systems fell within the pre-set cost and performance limits, indicated that additional system analysis was required. This was accomplished by synthesizing a system from the various subsystems previously analyzed that is most applicable to the region's requirements.

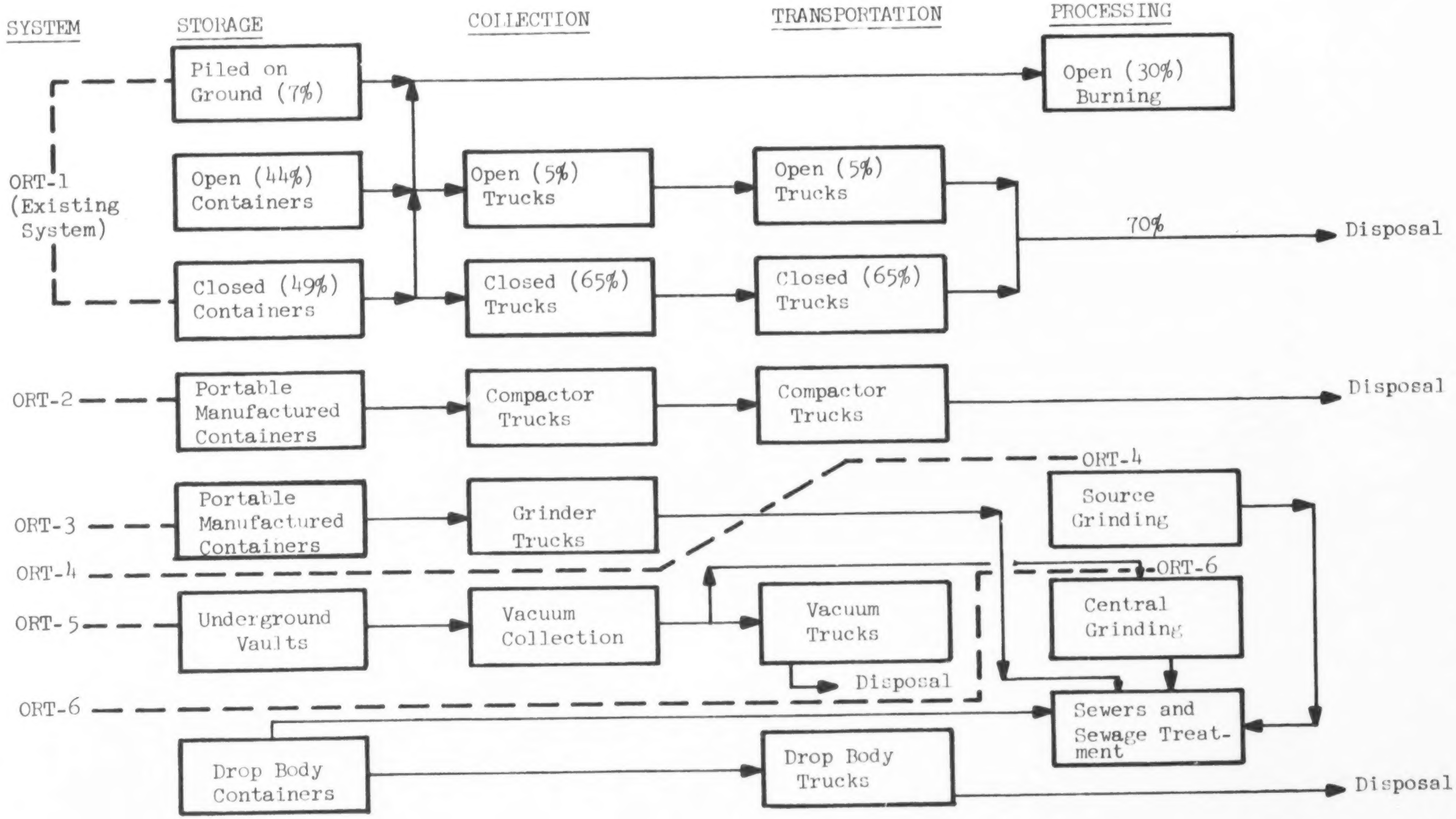
2. Major Wastes Evaluation

The individual postulated systems were developed on the basis of handling, essentially, all wastes by the particular methods shown and detailed in Section VII.

Further consideration indicates that three categories of solid waste in the Fresno region constitute almost two-thirds of the total amount generated. These are organic municipal refuse, organic industrial wastes and animal manures. To better enable application of nontechnical constraints, these three categories were specifically analyzed. Cost-benefit ratios for all technically feasible methods of handling, both transient and disposal, were determined for each of these three categories. Figures VIII-3, 4, and 5 display the transient components and Table VIII-5 the disposal components considered while Tables VIII-6, 7, and 8 provide performance scoring and cost data for the various combined subsystems developed for the three categories. Figures VIII-6, 7, and 8 furnish the results of the cost-benefit analysis for these additionally postulated subsystems.

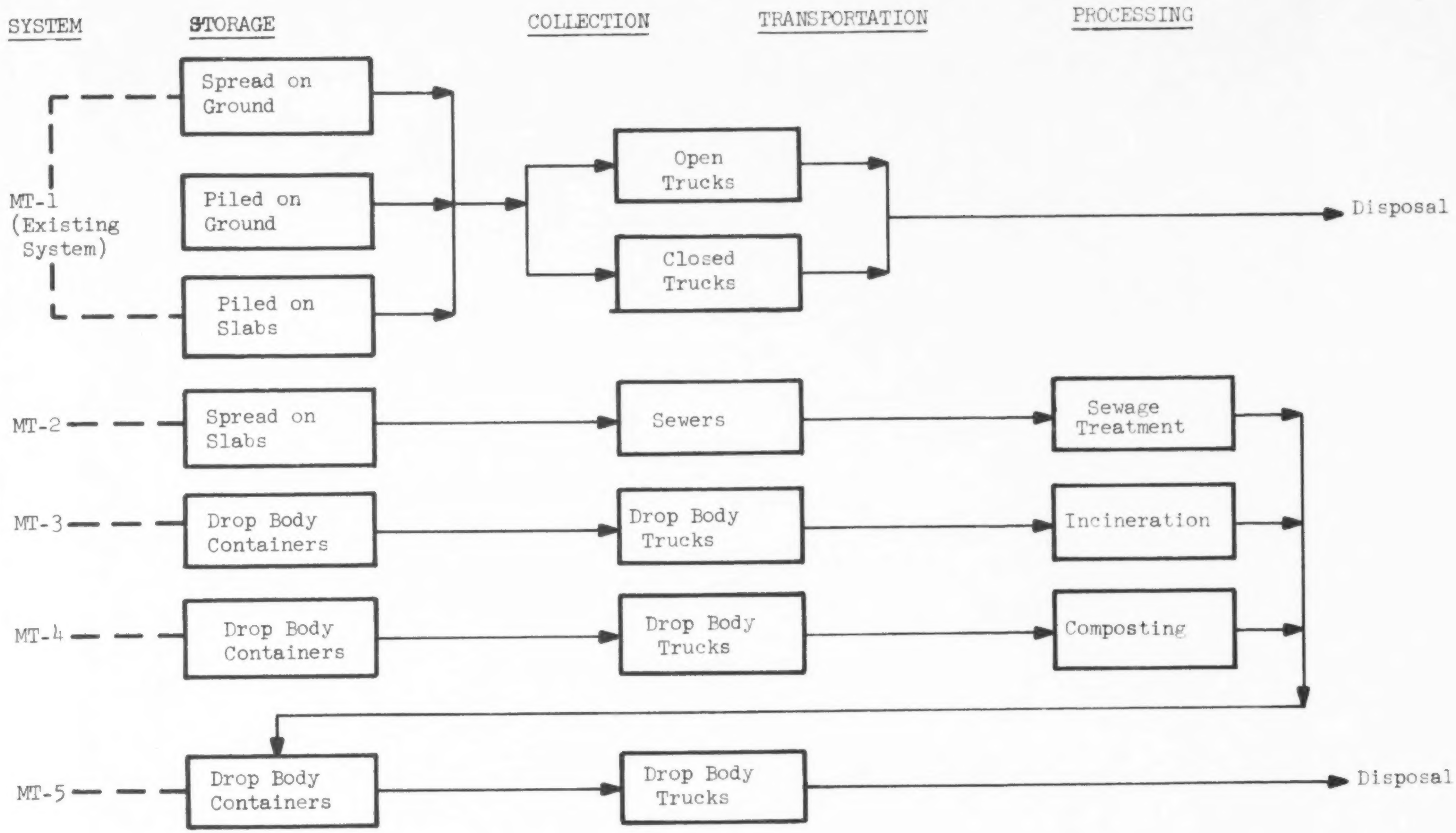
F. SYSTEM SELECTION

The final steps can now be taken to determine a rational solid waste management system for the study region. What has been accomplished to this point is the restriction of final choice to those systems or subsystems that produce the greatest environmental improvement for minimum increased expenditures. Until such time that additional sophistication can be incorporated into the computerization of system selection, it will be necessary to make the final choice on the further basis of sanitary engineering judgment accompanied by legal,


SYSTEM
STORAGE
COLLECTION
TRANSPORTATION
PROCESSING
ORT-1 (Existing System)
Piled on Ground (7%)
Open (44%) Containers
Closed (49%) Containers
Open (5%) Trucks
Closed (65%) Trucks
Open (5%) Trucks
Closed (65%) Trucks
Open (30%) Burning
70%
Disposal
ORT-2
Portable Manufactured Containers
Compactor Trucks
Compactor Trucks
Disposal
ORT-3
Portable Manufactured Containers
Grinder Trucks
ORT-4
Source Grinding
ORT-4
ORT-5
Underground Vaults
Vacuum Collection
Vacuum Trucks
Disposal
ORT-6
Central Grinding
ORT-6
Sewers and Sewage Treat- ment
Drop Body Containers
Drop Body Trucks
Disposal

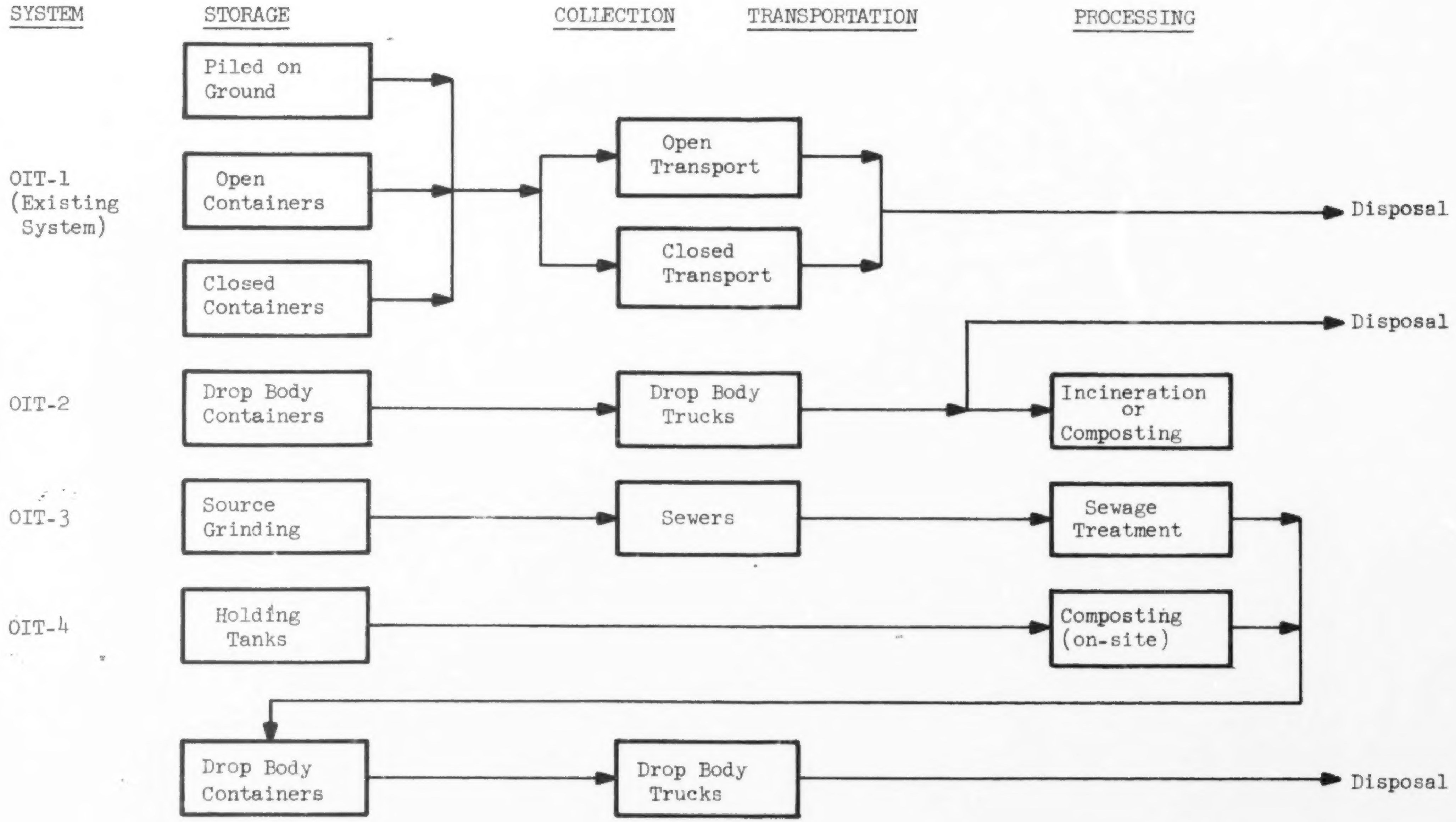
ORT - Organic Refuse Transient

Figure VIII-3. Transient Systems Organic Municipal Refuse


SYSTEM
STORAGE
COLLECTION
TRANSPORTATION
PROCESSING
MT-1 (Existing System)
Spread on Ground
Piled on Ground
Piled on Slabs
Open Trucks
Closed Trucks
Disposal
MT-2
Spread on Slabs
Sewers
Sewage Treatment
MT-3
Drop Body Containers
Drop Body Trucks
Incineration
MT-4
Drop Body Containers
Drop Body Trucks
Composting
MT-5
Drop Body Containers
Drop Body Trucks
Disposal

MT - Manures Transient

Figure VIII-4. Transient Systems Manures


SYSTEM
STORAGE
COLLECTION
TRANSPORTATION
PROCESSING
OIT-1 (Existing System)
Piled on Ground
Open Containers
Closed Containers
Open Transport
Closed Transport
Disposal
OIT-2
Drop Body Containers
Drop Body Trucks
Incineration or Composting
Disposal
OIT-3
Source Grinding
Sewers
Sewage Treatment
OIT-4
Holding Tanks
Composting (on-site)
Drop Body Containers
Drop Body Trucks
Disposal

OIT - Organic Industrial Waste Transient

Figure VIII-5. Transient Systems Organic Industrial Wastes

Table VIII-5

DISPOSAL SYSTEMS

System	Method
D-1	Existing System (See Section VII)
D-2	Plowed in the Ground
D-3	Incineration (Without Air Pollution Controls) - Ashes to Sanitary Landfill
D-4	Incineration (With Air Pollution Controls) - Ashes to Sanitary Landfill
D-5	Composting - Plowed in the Ground
D-6	Composting (On-Site) - Plowed in the Ground
D-7	Sanitary Landfilling
D-8	Sewage Treatment - Residue Plowed in the Ground

NOTE: D - Disposal

Table VIII-6

SUBSYSTEM SCORES

Organic Municipal Refuse

System	Per Cent Improvement			Cost/Ton
	Transient	Disposal	Average	
(A) ORT-1: D-1	0	0	0	$ 16.30
(B) ORT-2: D-3	45	78	61	28.40
(C) ORT-2: D-4	45	84	64	30.00
(D) ORT-5: D-3	97	78	87	36.40
(E) ORT-5: D-4	97	84	90	38.00
(F) ORT-2: D-5	15	74	44	30.30
(G) ORT-5: D-5	68	74	71	38.20
(H) ORT-2: D-7	31	70	50	23.00
(I) ORT-5: D-7	83	70	76	30.70
(J) ORT-3: D-8	15	56	35	19.40
(K) ORT-4: D-8	68	56	62	31.40
(L) ORT-6: D-8	68	56	62	30.50

NOTE: ORT - Organic Refuse Transient Subsystem

Table VIII-7

SUBSYSTEM SCORES

Manures

System	Per Cent Improvement			Cost/Ton
	Transient	Disposal	Average	
(A) MT-1: D-1	0	0	0	$ 2.57
(B) MT-5: D-2	72	0	36	1.80
(C) MT-3: D-3	71	73	72	28.50
(D) MT-3: D-4	71	84	77	30.50
(E) MT-5: D-7	69	59	64	4.95
(F) MT-4: D-5	59	85	72	14.60
(G) MT-2: D-8	85	39	62	3.90

NOTE: MT - Manure Transient Subsystem

Table VIII-8

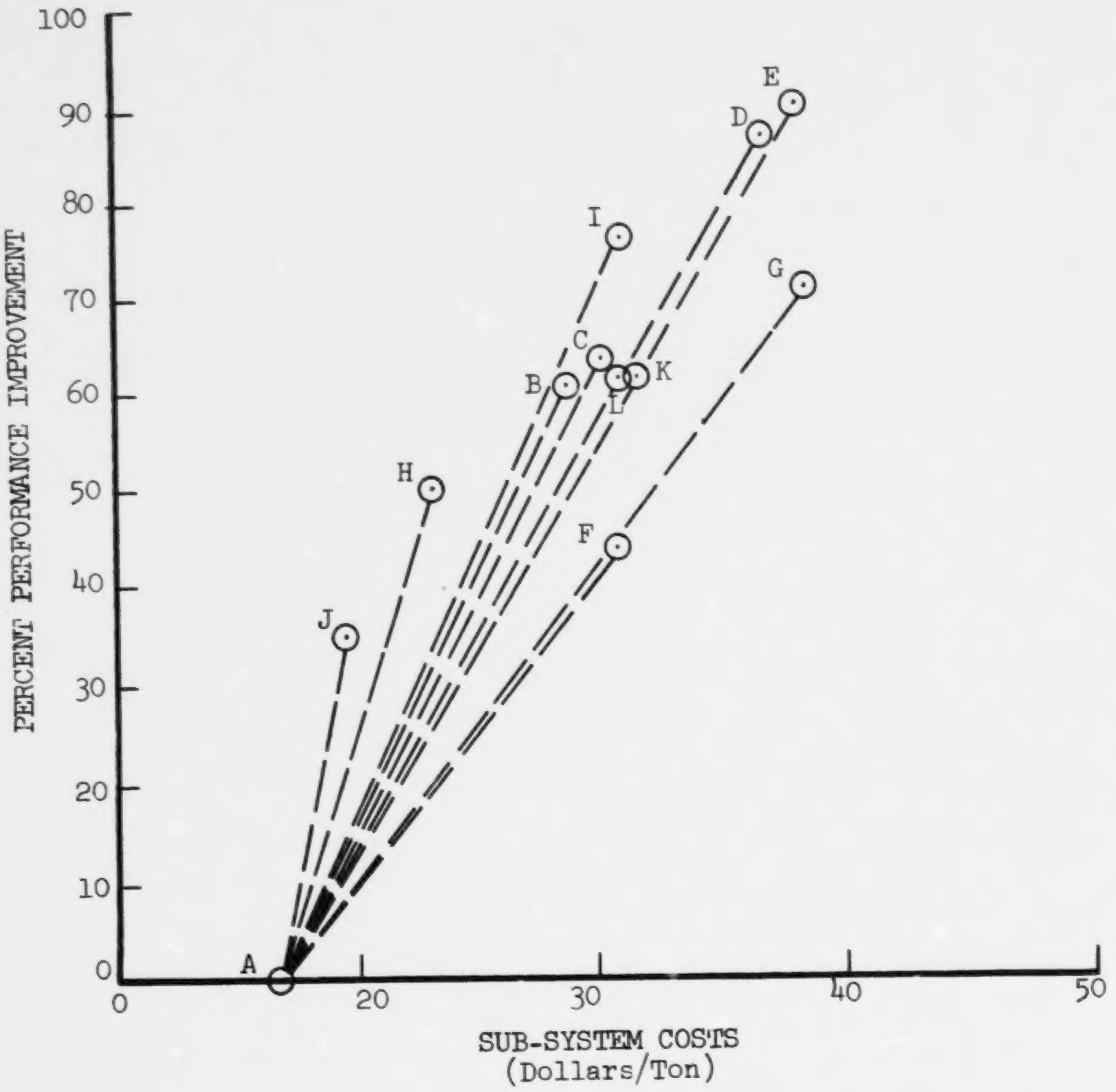
SUBSYSTEM SCORES

Organic Industrial Refuse

System	Per Cent Improvement			Cost/Ton
	Transient	Disposal	Average	
(A) OIT-1: D-1	0	0	0	$ 6.70
(B) OIT-2: D-2	20	19	19	3.30
(C) OIT-2: D-3	60	71	65	26.80
(D) OIT-2: D-4	60	87	73	28.80
(E) OIT-2: D-7	20	57	38	3.30
(F) OIT-3: D-8	75	65	70	5.00
(G) OIT-2: D-5	48	82	65	11.00
(H) OIT-4: D-6	80	82	81	9.00

NOTE: OIT - Organic Industrial Transient Subsystem

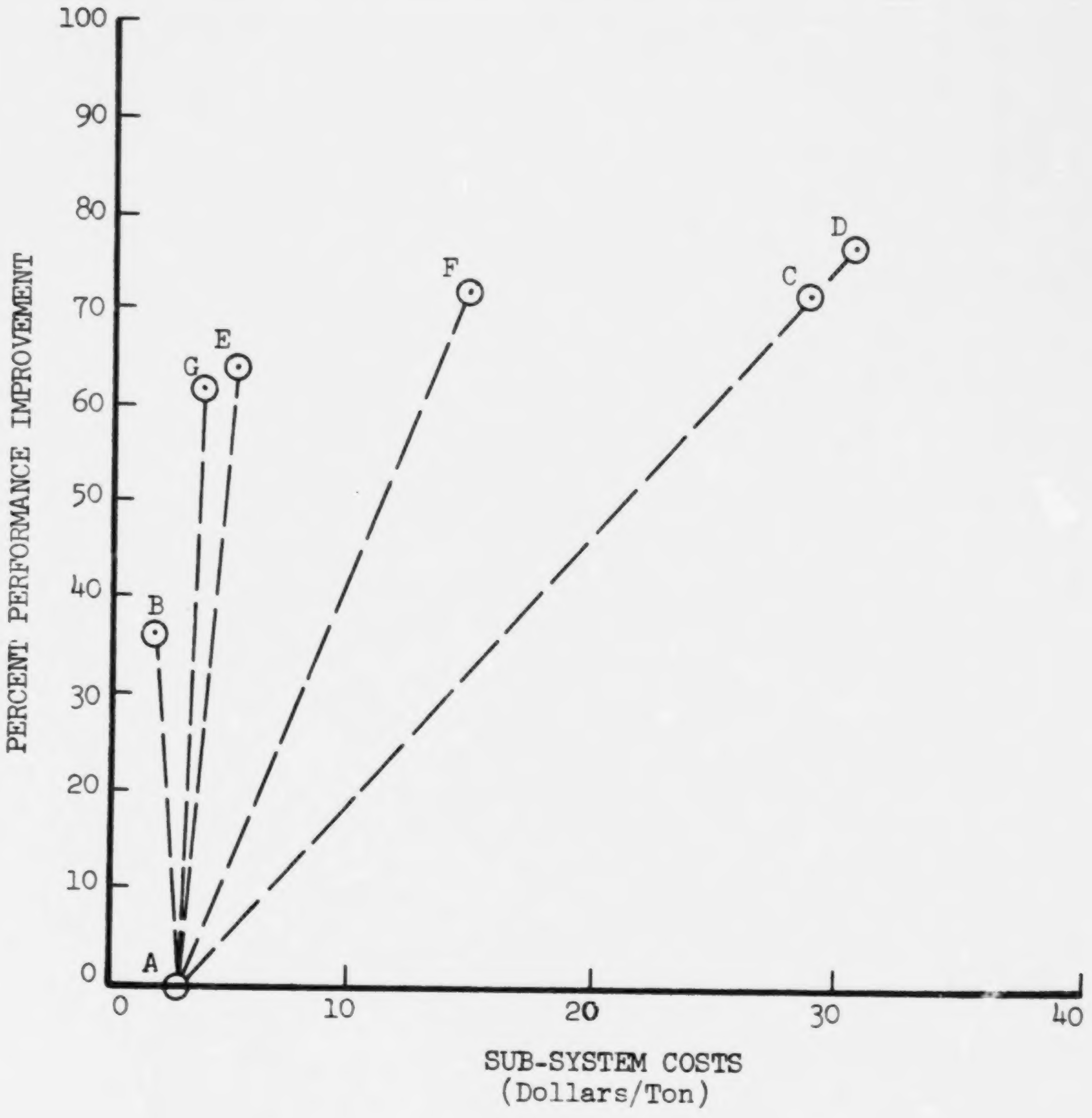
Year 2000



Note: 1. Pt. A represents existing system.
2. Slope from A to system designation represents % improvement per dollars expended.

Figure VIII-6. Cost-Benefit Analysis Organic Municipal Refuse Subsystem

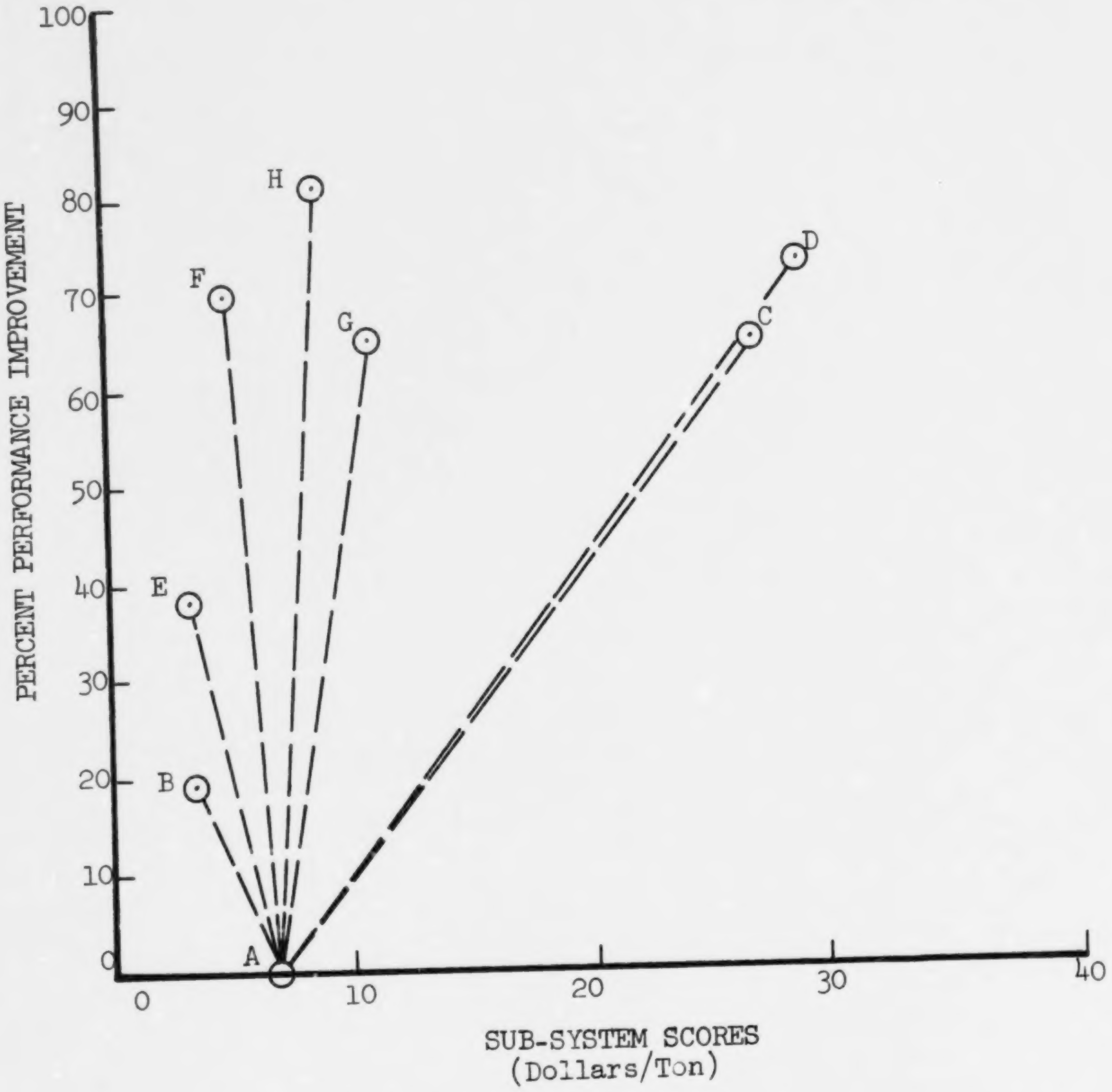
Year 2000



Note: 1. Pt. A represents existing system.
2. Slope from A to system designation represents % improvement per dollars expended.

Figure VIII-7. Cost-Benefit Analysis Manures Subsystem

Year 2000



Note: 1. Pt. A represents existing system.
2. Slope from A to system designation represents % improvement per dollars expended.

Figure VIII-8. Cost-Benefit Analysis Organic Industrial Refuse Subsystem

political and administrative decisions. Even in the event of future perfection of the technical-economic selection process, the legal, political, and administrative decisions, representing local awareness of public acceptance, could still remain overpowering. However, the decisions obtained by cognizant officials will be easier and better because of this improved selection process.

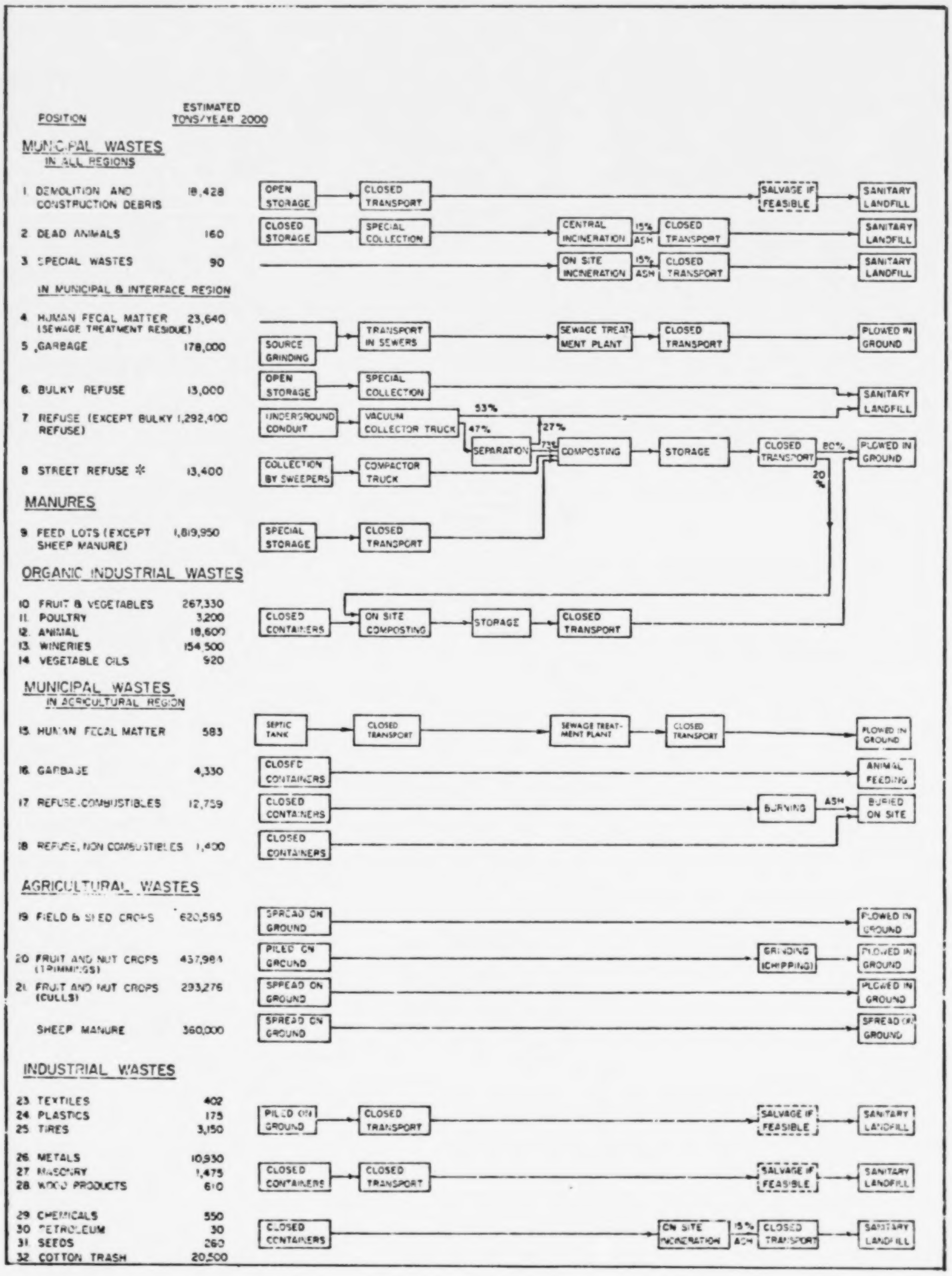
The cost-benefit analysis provided by Figure VIII-1 indicates certain management systems that fall within the determined performance and cost limitations. Table VIII-4 further provides a quantitative analysis of ancillary effects produced by those particular systems.

It is conceivable that engineering and administrative entities, using only the data presented, could now make better decisions regarding solid waste management selections. To further augment the procedure, however, a rationale for the selection of the postulated year 2000 Fresno solid waste management system is presented.

Approximately 5,557,000 tons of solid wastes (as defined by this study) will be generated within the study region in the year 2000. Of this total about 36 percent (1,987,000 tons) are relatively low contributors to adverse environmental effects, or are low in tonnage, ranging from 30 tons for petroleum wastes to 20,500 tons for cotton trash. This category includes 75 percent of the individual wastes considered in this study.

The remaining 64 percent of the total tonnage of generated wastes - consisting of some 25 percent of the individual wastes considered - fall into categories specifically analyzed in Subsection E, 2 of this section. These wastes, due to their organic nature, are particularly detrimental to the environment when improperly managed. It is thus readily apparent that devoting attention to these three putrescible categories will provide the greatest gains in environmental improvement.

The proposed solid waste management system for the Fresno region (as shown in Figure VIII-9) is a combination of the various transient and disposal systems heretofore described. The system handles the different waste


POSITION
ESTIMATED TONS/YEAR 2000
MUNICIPAL WASTES
IN ALL REGIONS
1 DEMOLITION AND CONSTRUCTION DEBRIS 18,428
2 DEAD ANIMALS 160
3 SPECIAL WASTES 90
IN MUNICIPAL & INTERFACE REGION
4 HUMAN FECAL MATTER (SEWAGE TREATMENT RESIDUE) 23,640
5 GARBAGE 178,000
6 BULKY REFUSE 13,000
7 REFUSE (EXCEPT BULKY REFUSE) 1,292,400
8 STREET REFUSE * 13,400
MANURES
9 FEED LOTS (EXCEPT SHEEP MANURE) 1,819,950
ORGANIC INDUSTRIAL WASTES
10 FRUIT & VEGETABLES 267,330
11 POULTRY 3,200
12 ANIMAL 18,600
13 WINERIES 154,500
14 VEGETABLE OILS 920
MUNICIPAL WASTES
IN AGRICULTURAL REGION
15 HUMAN FECAL MATTER 583
16 GARBAGE 4,330
17 REFUSE, COMBUSTIBLES 12,759
18 REFUSE, NON COMBUSTIBLES 1,400
AGRICULTURAL WASTES
19 FIELD & SEED CROPS 620,585
20 FRUIT AND NUT CROPS (TRIMMINGS) 437,984
21 FRUIT AND NUT CROPS (CULLS) 293,276
SHEEP MANURE 360,000
INDUSTRIAL WASTES
23 TEXTILES 402
24 PLASTICS 175
25 TIRES 3,150
26 METALS 10,930
27 MASONRY 1,475
28 WOOD PRODUCTS 610
29 CHEMICALS 550
30 PETROLEUM 30
31 SEEDS 260
32 COTTON TRASH 20,500
OPEN STORAGE
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
CLOSED STORAGE
SPECIAL COLLECTION
CENTRAL INCINERATION
15% ASH
CLOSED TRANSPORT
SANITARY LANDFILL
ON SITE INCINERATION
15% ASH
CLOSED TRANSPORT
SANITARY LANDFILL
SOURCE GRINDING
TRANSPORT IN SEWERS
SEWAGE TREATMENT PLANT
CLOSED TRANSPORT
PLOWED IN GROUND
OPEN STORAGE
SPECIAL COLLECTION
SANITARY LANDFILL
UNDERGROUND CONDUIT
VACUUM COLLECTOR TRUCK
53%
47%
27%
SEPARATION
73%
COMPOSTING
STORAGE
CLOSED TRANSPORT
80%
PLOWED IN GROUND
20 %
COLLECTION BY SWEEPERS
COMPACTOR TRUCK
SPECIAL STORAGE
CLOSED TRANSPORT
CLOSED CONTAINERS
ON SITE COMPOSTING
STORAGE
CLOSED TRANSPORT
SEPTIC TANK
CLOSED TRANSPORT
SEWAGE TREATMENT PLANT
CLOSED TRANSPORT
PLOWED IN GROUND
CLOSED CONTAINERS
ANIMAL FEEDING
CLOSED CONTAINERS
BURNING
ASH
BURIED ON SITE
CLOSED CONTAINERS
SPREAD ON GROUND
PLOWED IN GROUND
PILED ON GROUND
GRINDING (CHIPPING)
PLOWED IN GROUND
SPREAD ON GROUND
PLOWED IN GROUND
SPREAD ON GROUND
SPREAD ON GROUND
PILED ON GROUND
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
CLOSED CONTAINERS
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
CLOSED CONTAINERS
ON SITE INCINERATION
15% ASH
CLOSED TRANSPORT
SANITARY LANDFILL

*Leaves (only) to composting; dirt and sand to landfill

Figure VIII-9. Proposed Solid Waste Management System (Fresno Region)

categories in a variety of manners with the most intensive and advanced treatment reserved for three types of waste. These are the organic municipal refuse (part of category 7), feed lot manures (category 9) and organic industrial wastes (category 10 through 14). The categories referred to by number above are similarly numbered on Figure VIII-9.

The proposed system allows for an orderly transition over a period of time from the existing system to that being proposed for the major affected waste types. At the same time the system handling waste categories of little consequence or those that are presently efficient are little changed in the proposed system. The only departure from this concept is the treatment of agricultural wastes (categories 19 through 21). These wastes, though highly putrescible, are not given a great deal of special treatment in this system. To handle these wastes more intensively would, it was felt, require considerably more expenditure than the farmers could afford and still maintain their competitive position in the State and Country.

The costs of the proposed system in the year 2000 is estimated to be:

Municipal	42.7 million dollars
Industrial	5.9 million dollars
Manures	26.5 million dollars
Crop Residues	3.5 million dollars
Total	78.6 million dollars (1967 value dollars)

These system costs fall within the expenditure limits previously set in Subsection E-1 of this section.

The effectiveness of the proposed system is indicated by the calculated 84 percent improvement of damaging environmental effects for the municipal-industrial portion and an improvement of 70 percent for the agricultural portion.

In addition, the proposed system ancillary effect score of 17.24 is considerably lower than that of any of the previously postulated systems falling within the cost benefit limits. These improvements, well above the program goals and within reasonable expenditures, are the result of a successful application of the postulated procedures.

IX. SELECTED SYSTEM CONCEPTS

A. OBJECTIVES

The objective of this task is to define a long-range solid waste management system that would fit the basic needs of the Fresno Region Study Area. Details of incremental immediate and medium-range changes necessary to attain the proposed system in an efficient, orderly and economic manner are presented to provide a basis for initiating development. Technical, economic, legal, jurisdictional, political and financial considerations affecting the proposed system are included within this operational framework.

Primary consideration has been given to retention of a high degree of flexibility within the proposed system in order that incorporation of technological advancements could be achieved at minimal cost, and also to permit application of the data and methodology to regions outside the Fresno area.

B. CONCEPT DESCRIPTION

1. Introduction

The solid waste management system concept suggested for implementation within the study area differs from present system operations in source storage, collection, and processing of selected municipal and industrial wastes. The system, as suggested will readily lend itself to future expansion and utilization of envisioned technological advancements. Consideration is given to the maximum use of present operations to effect an efficient transition.

2. Upgrading of Present Waste Management System

Approximately 36 percent (1, 987, 000 tons per year) of the estimated total solid waste load in the year 2000 can be managed effectively by upgrading the present system. It is expected that all surface transportation of wastes will take place in closed transportation and that landfill operations will be effectively managed. Figure IX-1 is a schematic representation of systems operations for the various wastes produced in the year 2000. Those operations which can continue substantially unchanged, if this system is adopted, are as follows with position as indicated in Figure IX-1.

a. Demolition and Construction Debris (1), bulky refuse (6), and industrial wastes other than organic (23-32) will be collected into closed transportation units for disposal at sanitary landfills after feasible salvage operations.

b. Dead Animals (2) are to be disposed of at a central incineration unit with disposal of accumulated ash at sanitary landfills.

c. Special Wastes (3) will be disposed of by on-site incineration.

d. Garbage (5) will continue to be processed through the expanded use of source grinding (i. e. household disposals) with sewer transportation to the sewage treatment plant and ultimate disposal of the digested sludge by plowing in the ground.

e. Fruit and Nut Crop Trimmings (20) will be processed through a grinding operation and plowed into the ground rather than being disposed of through open burning.

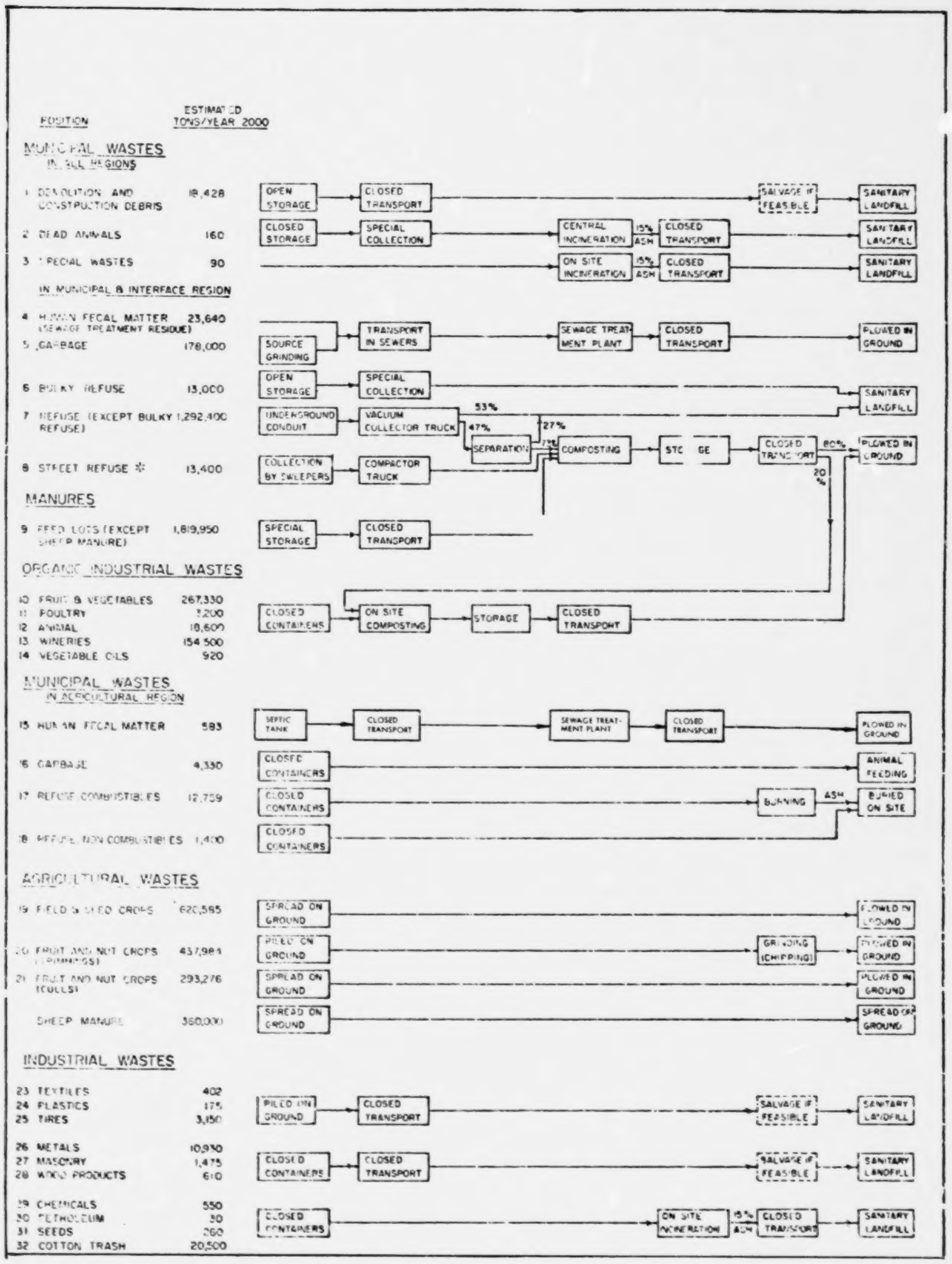
f. Industrial Wastes produced from chemical, petroleum, seed and cotton gin operations (29-32) will be incinerated with disposal of ash in sanitary landfills.

3. Operation of Proposed Waste Management System

That portion of the proposed waste management system which provides for partial automation of municipal refuse, collection, and composting or sanitary landfill disposal of municipal refuse, organic industrial wastes and manures (items 7 through 14 in Figure IX-1), accounts for 64 percent (3, 570, 000 tons per year) of the estimated total waste load. Of this quantity, about 849, 000 tons per year would be disposed of in sanitary landfills with the remainder used in the production of approximately 1, 143, 000 tons of compost per year.

a. Municipal Refuse

The proposed system provides for sealed storage and semi-automated collection of municipal refuse (Item 7 in Figure IX-1). Wastes


POSITION
ESTIMATED TONS/YEAR 2000
MUNICIPAL WASTES
IN ALL REGIONS
1 DEMOLITION AND CONSTRUCTION DEBRIS 18,428
2 DEAD ANIMALS 160
3 SPECIAL WASTES 90
IN MUNICIPAL & INTERFACE REGION
4 HUMAN FECAL MATTER (SEWAGE TREATMENT RESIDUE) 23,640
5 GARBAGE 178,000
6 BULKY REFUSE 13,000
7 REFUSE (EXCEPT BULKY REFUSE) 1,292,400
8 STREET REFUSE * 13,400
MANURES
9 FEED LOTS (EXCEPT SHEEP MANURE) 1,819,950
ORGANIC INDUSTRIAL WASTES
10 FRUIT & VEGETABLES 267,330
11 POULTRY 3,200
12 ANIMAL 10,600
13 WINERIES 154 500
14 VEGETABLE OILS 920
MUNICIPAL WASTES
IN AGRICULTURAL REGION
15 HUMAN FECAL MATTER 583
16 GARBAGE 4,330
17 REFUSE COMBUSTIBLES 12,759
18 REFUSE NON COMBUSTIBLES 1,400
AGRICULTURAL WASTES
19 FIELD & SEED CROPS 620,585
20 FRUIT AND NUT CROPS (TRIMMINGS) 437,981
21 FRUIT AND NUT CROPS (CULLS) 293,276
SHEEP MANURE 360,000
INDUSTRIAL WASTES
23 TEXTILES 402
24 PLASTICS 175
25 TIRES 3,150
26 METALS 10,930
27 MASONRY 1,475
28 WOOD PRODUCTS 610
29 CHEMICALS 550
30 PETROLEUM 30
31 SEEDS 260
32 COTTON TRASH 20,500
OPEN STORAGE
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
CLOSED STORAGE
SPECIAL COLLECTION
CENTRAL INCINERATION
15% ASH
CLOSED TRANSPORT
SANITARY LANDFILL
ON SITE INCINERATION
15% ASH
CLOSED TRANSPORT
SANITARY LANDFILL
TRANSPORT IN SEWERS
SOURCE GRINDING
SEWAGE TREATMENT PLANT
CLOSED TRANSPORT
PLOWED IN GROUND
OPEN STORAGE
SPECIAL COLLECTION
SANITARY LANDFILL
UNDERGROUND CONDUIT
VACUUM COLLECTOR TRUCK
53%
47%
27%
SEPARATION
73%
COMPOSTING
STORAGE
CLOSED TRANSPORT
80%
20%
PLOWED IN GROUND
COLLECTION BY SWEEPERS
COMPACTOR TRUCK
SPECIAL STORAGE
CLOSED TRANSPORT
CLOSED CONTAINERS
ON SITE COMPOSTING
STORAGE
CLOSED TRANSPORT
SEPTIC TANK
CLOSED TRANSPORT
SEWAGE TREATMENT PLANT
CLOSED TRANSPORT
PLOWED IN GROUND
CLOSED CONTAINERS
ANIMAL FEEDING
CLOSED CONTAINERS
BURNING
ASH
BURIED ON SITE
CLOSED CONTAINERS
SPREAD ON GROUND
PLOWED IN GROUND
PILED ON GROUND
GRINDING (CHIPPING)
PLOWED IN GROUND
SPREAD ON GROUND
PLOWED IN GROUND
SPREAD ON GROUND
SPREAD ON GROUND
PILED ON GROUND
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
CLOSED CONTAINERS
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
CLOSED CONTAINERS
ON SITE INCINERATION
15% ASH
CLOSED TRANSPORT
SANITARY LANDFILL

*Leaves (only) to composting; dirt and sand to landfill

Figure IX-1. Proposed Solid Waste Management System (Fresno Region, Year 2000)

would be bagged and placed in an underground conduit leading to a streetside pickup receptacle (Figure IX-2). This system has the advantage of eliminating outside storage and permitting convenient collection with a vehicle operated vacuum system. It should be understood that this system is conceptual and that a number of similar systems can be hypothesized. Approximately 50 percent of the refuse (7) would be hauled directly to sanitary landfills with the remainder passing through a separation process (removal of metal objects, etc.) before delivery to a composting plant.

b. Street Refuse

Collection of street refuse (8) would continue to be operated in the present manner but disposal of the collected material would direct leaves to be processed with municipal refuse at the composting plant, with the dirt and sand disposed of in sanitary landfills.

c. Manures

Feedlot-generated manures (9) in the proposed system are to be processed at the composting plant with refuse. A C/N ratio of 30 to 40 is required for rapid composting which necessitates maintaining a proper balance between refuse (high C/N ratio) and manures (low C/N ratio). The generated compost would then be prepared for storage and delivery to the user.

d. Organic Industrial wastes (10 through 14) will be processed by on-site composting. A portion of the compost produced by the municipal refuse-manure composting operation will be required for use as C/N ratio control and as a dry absorbent for the wet cannery (10) and winery (13) wastes.

C. ELEMENTS OF SYSTEMS

1. Storage

a. Storage in Containers

Closed containers should be designed for convienent handling as well as for control of flies and rodents. The containers should be esthetically pleasing and provided with a tightly fitting lid.

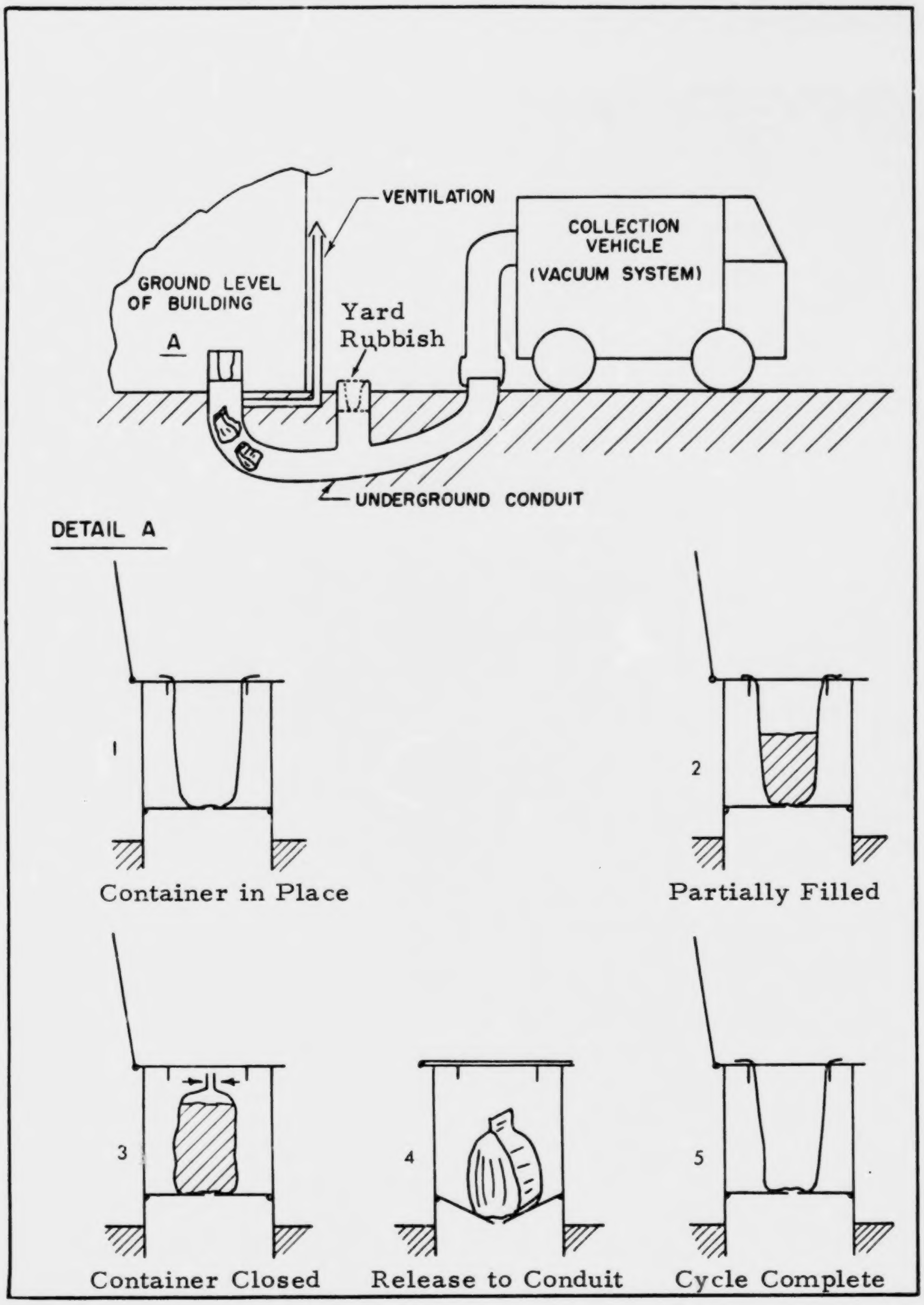

VENTILATION
COLLECTION VEHICLE (VACUUM SYSTEM)
GROUND LEVEL OF BUILDING
A
Yard Rubbish
UNDERGROUND CONDUIT
DETAIL A
1
Container in Place
2
Partially Filled
3
Container Closed
4
Release to Conduit
5
Cycle Complete

Figure IX-2. Municipal Refuse: Storage in Underground Conduits and Automated Pickup by Vacuum System (Concept Represents One of Several Solutions)

Larger volume containers, like "lift-and-carry" containers, will be required for the storage of commercial and industrial wastes. The organization providing the collection service must be authorized to specify the required containers.

b. Underground Conduits

It is proposed that municipal refuse (except bulky refuse) be stored in underground conduits that connect directly to the collection vehicle at time of pick-up. This new storage-collection concept is shown schematically in Figure IX-2.

Refuse would be packaged in heavy duty paper bags supported in an upright open position until filled. The bags would then be closed by means of an adhesive tape and the closed bag discharged into the underground conduit. The collection vehicle would be equipped with a vacuum system. Air circulation in the underground conduit would be provided by a vent and the conduit would be constructed to exclude storm water drainage.

This system would provide for the sanitary storage of wastes in readily accessible locations and for orderly handling and collection with a maximum convenience to collection agency as well as the householder. Furthermore, the system can be considered as a first step in the development of advanced methods of collection and transportation. Future systems could incorporate a sewer line as the transportation facility by initially providing the collection vehicle with a grinder that would discharge ground wastes into the sewers. Ultimately, home refuse grinders could discharge the material directly to the sewers.

c. Special Storage for Manures

The proposed system, if adopted, by providing for composting of manures makes transportation of the manures mandatory.

The problem of storage and transportation of manures is mainly one of getting the manures into containers. This might be accomplished by having wastes scraped off by means of an automated shovel and stored in closed lift-and-carry containers. This system of storage could be modified in such a way that manures would be washed into special settling containers providing mechanical separation of solids and reclamation and reuse of treated waters. Drainage could be lagooned or discharged to the sewers if available.

2. Collection

It is beyond the scope of this study to specify all vehicles that could be used for collection and transportation. The following paragraphs will, therefore, consist of general recommendations.

Only "closed transport" is recommended. This does not necessarily mean that open body trucks are excluded but wastes being transported in an open body truck should be covered with a tarpaulin.

a. Special Collection

Bulky refuse, dead animals and demolition debris are not collected on a regular schedule. Fast and efficient collection depends on the service provided. It is recommended that the same organization be responsible for the collection and processing of dead animals. The vehicles for the collection of dead animals should be sufficiently equipped to assure a safe and hygienically inoffensive operation.

b. Vacuum Collector Trucks

These trucks would be used for the collection of municipal wastes stored in underground conduits. The trucks would be equipped with a vacuum system powered by the truck engine. Since the wastes are to be packed in heavy duty paper bags there will be no air pollution caused by the carrier air. The truck should be of the "compactor type" in order to optimize its capacity.

Vacuum collector trucks of this character are not presently on the market; therefore, it is recommended that development of this underground storage and vacuum collection system be carried out by the pertinent industry.

3. Transport

Transportation is considered as that part of solid waste management where collected wastes are transported between any major functions in the total waste management system.

The selection of the best combination of methods and equipment to meet the requirements of a particular situation is largely a matter of cost analysis and economics. A detailed cost analysis of collection and transportation for the study region is beyond the scope of this study. It is, therefore, only indicated on which basis an analysis should be carried out by the following example. Three different systems are assumed:

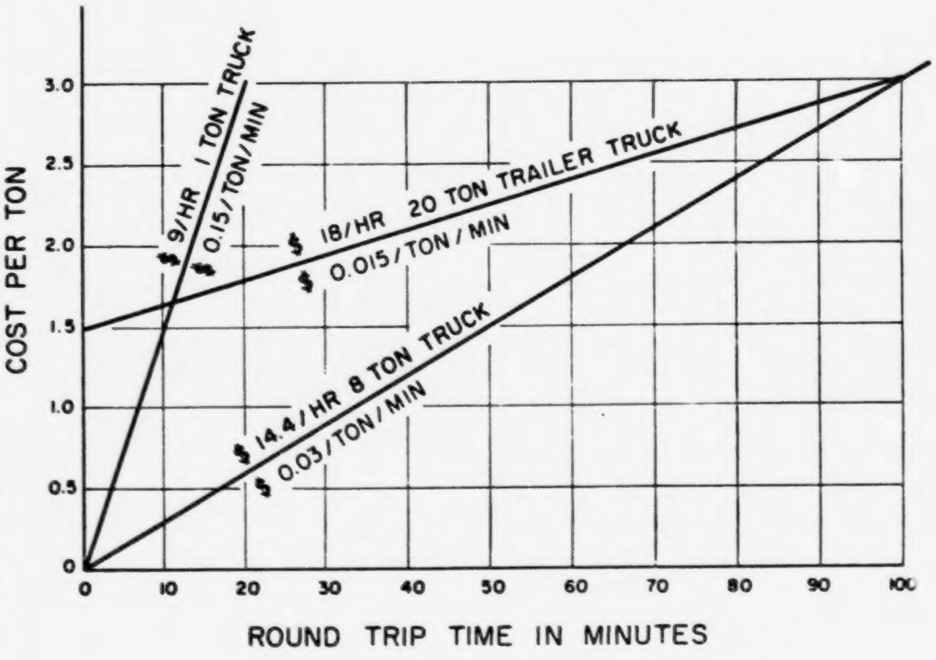
(1) Transportation by 1-ton collection truck, costing \$9.00/hour, equivalent to $\frac{9}{1 \times 60}$ = \$0.15/ton/minute

(2) Transportation by 8-ton collection truck, costing \$14.40/hour, equivalent to $\frac{14.4}{8 \times 60}$ = \$0.03/ton/minute

(3) Transfer station, costing \$1.50/ton and transportation by 20-ton trailer-truck, costing \$18.00/hour, equivalent to $\frac{18}{20 \times 60}$ = \$0.015 ton/minute

Figure IX-3 indicates that a transfer station is more economical if the time for a round trip of a 1-ton truck is longer than 12 minutes. However, 8-ton trucks are still more economical when the time is less than 100 minutes.

This type of analysis (discussed in detail in Reference 2) would be required on a region-wide basis considering the location of future processing and disposal sites.



BASED UPON
APWA DOCUMENT
(REFERENCE 2)

Figure IX-3. Refuse Haul Cost Comparison (Transfer Versus Direct Haul)

4. Processing

a. Garbage Grinding

Installation of household garbage disposal units in all new homes, as well as installation in existing homes not already equipped, has become a reality of modern living. Clark et. al., (7) have reported that the installation of garbage grinders increased the per capita domestic BOD and TSS loads an average 35 percent in several observations. However, they also reported that increases in per capita sewage volume due to garbage grinders were insignificant. The relative C:TN composition (carbon:total nitrogen) of macerated garbage (a mixture rich in organic matter) entering the sewers was estimated to be about 100:7.5, which is compared to the C:TN ratio in sewage of about 100:20. Thus, the installation of garbage grinders would be expected to increase the domestic waste load coefficients for BOD, TN, and by about one third total suspended and dissolved solids. These factors must be considered in designing new or expanded sewerage facilities.

b. Central Incineration of Dead Animals

It is proposed that dead animals be burned in a central incineration plant, especially designed for incineration of dead animals. The incinerator for this purpose should be equipped with auxiliary oil burners. The temperature of the flue gases leaving the combustion chamber should be higher than 1800°F to accomplish odor-free operation. Exhaust cleaning facilities would be required to meet air pollution control regulations. Such a plant would operate on a "call service" basis.

c. On-Site Incineration of Special Wastes

Special wastes, as defined in this study, refer to pathological wastes generated in hospitals, including operating room wastes, experimental animals, etc. These wastes would be disposed of in incinerators specifically designed for this purpose. Auxiliary fuel, after-burner, gas-cleaning and adequate safety devices are some of the necessary components of such equipment.

Most importantly, regardless of hospital size, the wastes require thorough burning and preferably no storage. Wastes generated in hospitals, other than pathological, amount to about nine pounds/bed/day. These wastes should be handled by standard collection methods since incinerators designed for specific purposes are uneconomical when used to burn refuse.

d. Composting of Municipal Refuse and Manures

In the proposed system, part of the municipal refuse would be composted in combination with manures. Municipal wastes having a high C/N (carbon-nitrogen) ratio would be used to adjust the low C/N ratio of manures to maintain a compostable mixture.

The composting process includes three major phases: preparation of raw materials, composting, and preparation of final product.

(1) Preparation of Raw Material

Scales are an essential requirement for the operation of a composting plant to determine inputs and outputs of the operation. The raw materials reach the composting in batches; therefore, in-process storage facilities would also be required. It is recommended that wastes should not be stored longer than one day. Storage facilities should be designed to facilitate daily cleaning, i.e., the bunkers should be empty after one day's operation. Closed buildings are necessary to prevent scattering at materials and to assure odor-and-rodent-free operation.

Separation is a prerequisite for efficient composting. A first separation is possible by selecting collection routes which would yield the best raw material for composting. (This is possible in the Fresno study area, because the proposed system requires that only about half of the municipal refuse should go to the composting plant.) In the plant, compostable materials would be segregated automatically by means of ballistic and magnetic separation. Parallel to separation, there will be a reduction of size to optimum particle size distribution. Separated materials such as ferrous constituents may be of marketable value; however, their value will be influenced by quality requirements.

Because the selected system includes composting of manures combined with municipal refuse, the plant would include mixing of manures and pre-treated refuse as an additional unit operation.

(2) Composting

The factors fundamental to composting are those fundamental to any aerobic biological process: initial population of micro-organisms; available nutrients, temperature, hydrogen ion concentration, moisture, and aeration. The course of this process and the time required are determined by moisture content, aeration and the C/N ratio. For best results the moisture content should be between 45 and 65 percent and the C/N ratio 30:1 to 40:1.

(3) Preparation of Final Product

Compost is usually stored at the plant for "ripening." Aerobic conditions are essential during this period. Frequent turning or forced aeration may be necessary. Final preparation could include sieving, drying and eventually briquetting or bagging with applicable quality control tests. Economics will probably dictate that most of the finished products be delivered in bulk form.

e. Composting of Organic Industrial Wastes

Industrial wastes in the study area consist mainly of cannery and winery wastes. These wastes are characterized by their high moisture content and the relatively high C/N ratio of the solids. The composting process, developed by the "National Canners Association" (1) is recommended for managing these wastes. This process is briefly discussed in the following paragraph.

Dry compost can be used as an absorbent for wet cannery wastes. Wet cannery wastes (85 percent moisture) are mixed with dry compost. The recommended moisture content of the mixture should be between 60 and 70 percent. This allows mixing of 2 units of wet wastes with one unit of dry compost (moisture content between 20 and 40 percent).

Evaporation of water and thermophilic microbial action will reduce the initial amount of cannery wastes to such a degree that the weight and volume of the finished compost is only slightly increased when recycled several times. It is recommended that the compost be contained between permanent walls and aerated by injecting air through the compost mass. Waste can be added at 12-hour intervals. Automated means of turning the composting mass, and waste distribution systems are already developed for the addition of waste to the windrow as it is being turned.

This system is simple but nevertheless effective. It does not require expensive investment for equipment that will be used only during a short period during the year (canning season).

f. Incineration of Industrial Wastes

The selected waste management system includes on-site incineration of industrial wastes like chemicals, petroleum, seeds and cotton trash. The incinerators would be small units, operated by the industries themselves. It is essential that these plants are built for the disposal of a specific type of waste. Petroleum and chemical wastes are probably best managed by burning in a rotary kiln, whereas cotton trash should be burned in a furnace where special attention is given to the low density of the fuel. All incineration plants must be approved by air pollution control agencies to receive an operation permit.

g. Salvage

Salvage techniques have not been adequately developed, technologically and economically; much research and development is needed. The term "salvage" is presently not exactly defined because it may include recycling of materials that essentially are not a part of the waste stream as well as segregation of materials from mixed wastes.

Direct recycling or reduction of wastes at their source is only applicable where wastes are homogeneous and the storage-collection function will not be complicated. These conditions prevail most frequently in commercial and industrial operations.

Under present conditions the most promising materials for salvage operations are:

(1) Metals

The scrap metal industry is presently one of the ten leading industries in the country, if the dollar volume is used as an index. The industry is interested in research and ways to upgrade scrap in order to widen its application in steel and other manufacturing industries. "Tin" cans have a special outlet through established channels at premium prices.

(2) Paper

Paper is probably the component with the greatest salvage potential. It provides about 25 percent of the raw material for the paper and paperboard industries. This percentage is relatively low compared to figures from other countries. Since paper is the largest component in municipal wastes (45 percent by weight) any salvage operation would reduce the waste load to be disposed of significantly. Significant are the de-inking plants built at Garden City, New Jersey, and Pomona, California, for the direct re-cycling of newspaper back into the re-use cycle.

(3) Glass

Salvage of glass appears to be the least promising salvage operation, because the range of processing and contaminant removal costs is limited by the low cost of basic raw material used in glass manufacturing. Some recent recovery of broken glass for decorative "land cover" in gardens and residential areas may prove to be a practical outlet.

(4) Rubber

Discarded automobile tires constitute the major source of scrap rubber. The availability and suitability of reclaimed rubber reduces the amount of crude rubber needed. However, shipment costs are a limiting factor in the economics of any rubber salvage operation.

(5) Plastics

In general, plastics fall into two main groups -- thermoplasts and thermosets. These two types cannot be used as a mixture because of their different properties. Salvage of plastics is for all practical purposes, limited to "in-house" recycling by industries.

(6) Rags

Rags salvaged from municipal refuse are of little use to the paper industry because only natural fibers can be used. Removal of the synthetic fiber and decontamination of the cotton and wool portion are economically unfeasible. Rags used in the paper industry are obtained directly from textile factories in an uncontaminated state; however, other outlets may exist and should be explored.

(7) Food Processing Wastes and Crop Residues

The potential value for animal feed and the production of chemical by-products such as alcohols suggests a serious study and possible exploitation of these potentially valuable solid wastes.

5. Disposal

a. Sanitary Landfilling

The operation of a landfill should be carried out by trained personnel and appropriate equipment should be made available.

Any new disposal site (sanitary landfill) should be prepared considering the following aspects: Engineering survey of the area, access road, esthetics (fencing), facilities for storage of equipment, scales for weighing incoming refuse and adequate utilities. Particular attention should be given to the ultimate use of the site when completed.

Deposited wastes must be covered daily. The material should be of sufficient depth and compaction to prevent fly emergence. Percolation of groundwater through the fill must be avoided. Attention must also be given to gas production and gas dispersion. Carbon dioxide should not reach the groundwater because this would result in mineralization of the ground water. Local buildup of methane should be prevented by ventilation.

b. Plowing in Ground

This method of disposal, applicable only when agricultural land is available, requires prompt plowing immediately after spreading the wastes on the ground.

D. WASTE LOADINGS

1. Required Capacities

a. Plant Sizes

The following paragraphs describe the physical size of processing facilities for the proposed system.

(1) Central incineration of Dead Animals

The projected load of dead animals for the year 2000 amounts to 160 tons/year. It is recommended that the plant consist of two units designed to handle unit charges of 1,200 pounds (large animals) and 200 pounds (small animals), respectively. This type of plant must include additional facilities for the cleaning and disinfection of collection vehicles.

For cases of emergency, when storage of dead animals will be necessary, it is recommended that closed storage rooms be ventilated and the odor-laden, vented air be used for air supply in the auxiliary oil burners or that refrigerated storage be used where practical.

(2) On-Site Incineration of Special Wastes

The capacities of hospital incinerators cannot be specified at this point, because the future waste loads were developed on the basis of overall population forecasts and not individual hospital sizes. Therefore, the distribution of the wastes has not been determined and plant capacities cannot be calculated. As in the design of incineration for dead animals, hospital incinerators should be operated with minimum storage periods. Any odor-laden air from storage rooms should be used for air supply in gas or oil burners.

(3) Composting Plants

As previously discussed, a proper carbon-nitrogen ratio (C/N) is an important factor in any composting operation. The reported C/N ratios are about 85:1 for refuse (2) and about 8:1 to 12:1 for manures (3).

Composting studies conducted by the University of California (4) indicated a C/N ratio of 30:1 to 40:1 for good composting; however, German researchers (5) recommended an initial C/N ratio of about 15:1 to reduce the initial lag time of the biological action.

Assuming that an initial C/N ratio of 25:1 can be used for composting a mixture of refuse plus manures, the amount of refuse required for composting is determined by the following equation:

Manures:	1,819,950 tons,	C/N ratio 10:1
Refuse:	X	C/N ratio 85:1
Mixture:	(1,819,950 + X),	C/N ratio 25:1

$$1,819,950 \cdot 10 + X \cdot 85 = (1,819,950 + X) \cdot 25$$

$$X = 456,800 \text{ tons}$$

This amount would consist, according to the flow chart, of separated refuse and street refuse. The fraction of non-compostable and easy to segregate materials in refuse is assumed to be 27 percent (2). The amount of refuse required for the "composting-stream" is, therefore:

$$X = (456,800 - 13,400) \frac{1}{0.73} = 608,400 \text{ tons,}$$

or 47 percent of the collected refuse. The remaining 53 percent would go directly to the landfill after collection.

The weight of the incoming mixture (2,276,750 tons/year) would be reduced by approximately 50 percent through composting. Considering the almost insignificant weight increase of that portion of compost being used for processing of organic industrial wastes, the amount of compost produced will be approximately 1,143,000 tons/year.

The required plant capacities are based on the total annual amount of 2,276,750 tons of refuse plus manure that will have to be processed if the selected system is adopted. Assuming five days/week and six days/week operation, the required capacities are 8, 750 tons/day and 7, 350 tons/day, respectively.

(4) Composting of Organic Industrial Wastes

The proposed plants were described functionally in Paragraph C. 4 of this section. All these processes would be carried out at the particular industrial plant sites. Specific capacities cannot be determined because the waste loadings are not broken down into single plants. The organic industrial wastes that would be processed by the NCA-process (National Canners Association) amounts to 444, 550 tons/year. Almost 95 percent of these composting plants would be operated on a seasonal basis at canneries or wineries.

(5) On-Site Incineration of Industrial Wastes

An exact determination of on-site incineration capacities cannot be made because a breakdown by plant of the estimated overall waste load (21, 340 tons/year) is not available. Furthermore, these incinerators will not be operated continuously and any specification of unit capacities here would be meaningless.

b. Land Required for Landfill

There would be approximately 900, 000 tons of wastes/year disposed of by sanitary landfilling. The average density of mixed refuse is reported as 300 pounds/cubic yard (2). Volume reduction by compaction varies from 1:1 to 3:1. The quantity of cover material is usually expressed as the ratio of the volume of cover material to the volume of compacted refuse. The average of this ratio is about 1:4. One ton of refuse requires, therefore, about 2 to 3 cubic yards of space for disposal. Applying these factors to the study region, indicates that 1, 800, 000 to 2, 700, 000 cubic yards, or 1, 110 to 1, 650 acre-feet/year, would be required by the year 2000 for waste disposal by sanitary landfilling.

c. Land Required for Compost Application

The production of compost in the year 2000 would be 1, 143, 000 tons. Assuming an application rate of 75 tons/acre/year, the required acreage is:

$$\frac{1,143,000}{75} = 15,400 \text{ acres}$$

or 24 square miles.

The distribution of the required acreage is discussed in Paragraph E of this section.

2. Required Equipment

a. Storage Facilities

Maximum periods of source storage were developed in Chapter VI (Chapter VI-23). Based on the figures presented in Table VI-23, and the estimated waste loadings, the required storage facilities can be determined. They are presented in Table IX-1. Only those wastes are considered that should be stored in containers, i. e., open storage is not included in the table.

Continuous generation and accumulation is assumed for all wastes with the exception of cannery and winery wastes where a three month canning season is assumed.

b. Collection and Transportation Facilities

Only the most important transportation capacities that are essential for the operation of the proposed waste management system will be determined. Any transportation capacity is determined by the tonnage to be transported within a given time period.

(1) Refuse Collection - Transportation System

It is assumed that refuse is collected during 6 days in a week. The capacity of the refuse collection-transportation system is, therefore:

$$\frac{1,292,400 \times 7}{52 \times 6} = 2,900 \text{ tons/day}$$

(2) Transportation of Manures

Because composting is a continuous process and refuse is collected regularly, it is desirable that manures be transported to

Table IX-1

REQUIRED STORAGE FACILITIES FOR STORAGE IN CONTAINERS

Waste	Max. Period of Source Storage (days)	Waste Load in Year 2000 (tons/year)	Required Storage (tons to be stored)
Municipal Wastes	4		
Garbage (Agr. region)	4	4,330	48
Refuse (Mun. and interface region)	4	1,292,400	14,200
Bulky Refuse (Mun. and interface region)	7	13,000	250
Refuse (Agr. region)	4	14,159	153
Dead Animals	1	160	1
Demolition and Construction Debris	7	18,428	355
Special Wastes	1	90	1
Ash	14	2,270	87
Agricultural Wastes			
Manures	7	1,819,950	35,000
Industrial Wastes			
Fruit and Vegetables	1	267,330	2,930
Poultry	1	3,200	9
Animal	1	18,600	51
Wineries	1	154,500	1,700
Vegetable Oils	1	920	3
Textiles	7	402	8
Plastics	14	175	7
Tires	14	3,150	121
Metals	14	10,930	418
Masonry	7	1,475	28
Wood Products	14	610	23
Chemicals	7	550	11
Petroleum	7	30	1
Seeds	7	260	5
Cotton Trash	7	20,500	394
		Overall Total	55,804

the composting plant regularly to prevent stockpiling and its resultant effects. The transportation system and collection service should be designed to meet the following requirements:

$$\frac{1,819,950 \times 7}{52 \times 6} = 4,100 \text{ tons/day}$$

E. APPLICATION OF SYSTEM

The proposed system will require considerable land acquisition for efficient management. The figures developed in the following paragraphs should be helpful for the planning of disposal sites and composting operations.

1. Required Disposal Acreages

A brief review of the projected waste loadings provides approximate figures for the magnitude of the required acreage. Table IX-2 is a summary of the total waste loading projections for the three major waste categories for the Fresno region.

Table IX-2

TOTAL REGIONAL WASTE LOADING PROJECTIONS

	Waste Loading (Tons per Year)			
Source	1970	1980	1990	2000
Municipal	450,000	680,000	1,020,000	1,530,000
Agricultural	2,020,000	2,630,000	3,030,000	3,530,000
Industrial	260,000	320,000	420,000	510,000
	2,730,000	3,630,000	4,470,000	5,570,000

It has been estimated that by the year 2000 approximately 900,000 tons of waste/year will be disposed of in sanitary landfills. The total 1970 waste production (municipal and industrial wastes) is anticipated to be disposed of by sanitary landfilling since at this time no composting operation will be operated on a large scale. It is assumed that composting will develop gradually through the thirty year period from 1970 to 2000 with full operation in 2000 as described previously. The amount of wastes going to sanitary landfills in 1970 is, therefore, about 700,000 tons, increasing to an annual rate of about 900,000 tons in 2000. These figures are shown in Figure IX-4. A straight line increase has been assumed. The area under

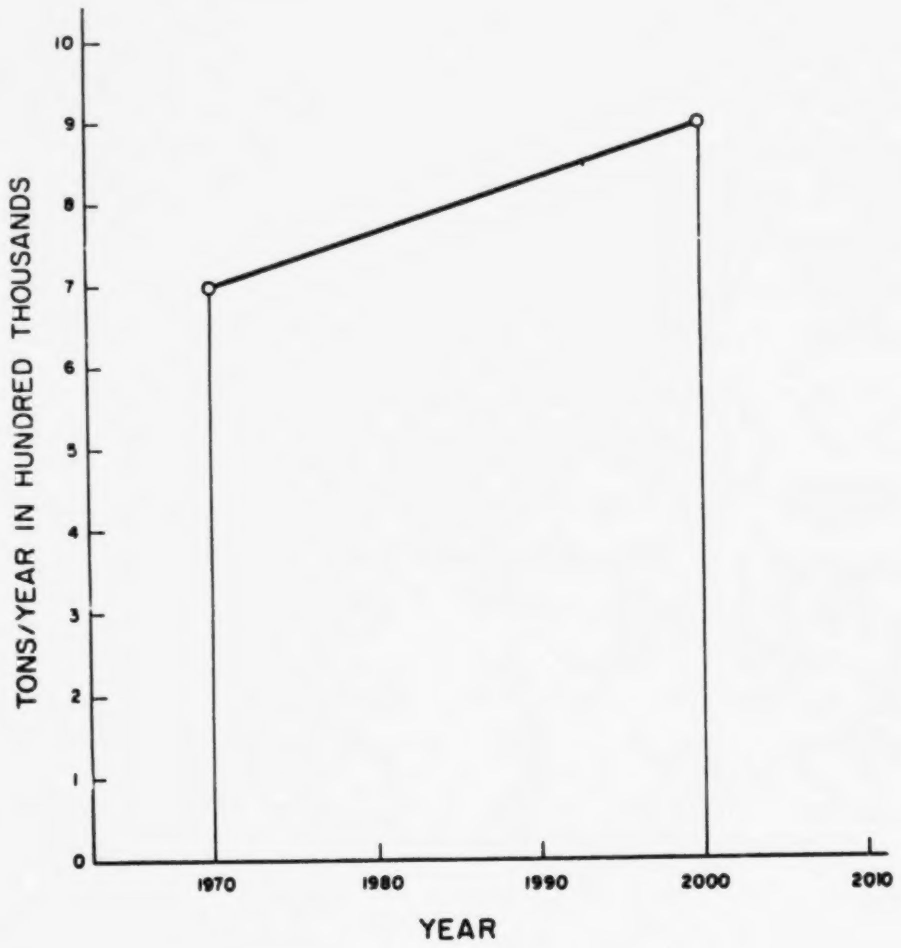


Figure IX-4. Waste Loadings to be Disposed of by Sanitary Landfilling

the waste loading curve in Figure IX-4 represents the total amount of wastes that will be disposed of by sanitary landfilling for the thirty year period: a total of 24, 000, 000 tons.

It is not feasible to fix with any degree of reliability the required area which will be needed because of the many parameters involved (density of wastes, volume reduction, cover material, geological conditions, and dimensions of fill). However, it is possible to estimate the required acreage if the total volume of the waste load to be disposed of by landfilling is known, (volume = area x depth). Waste volumes are determined by assuming three different waste densities: 0. 5 tons/cubic yard (compacted refuse), 0. 33 tons/cubic yard, and 0. 25 tons/cubic yard (refuse as is). Thus, the estimated volumes are: (1 ac-ft = 1, 613 cubic yards)

$$V_1 = \frac{24 \cdot 10^6}{0.5 \cdot 1.613 \cdot 10^3} \approx 30.000 \text{ ac-ft}$$

$$V_2 = \frac{24 \cdot 10^6}{0.33 \cdot 1.613 \cdot 10^3} \approx 45.000 \text{ ac-ft}$$

$$V_3 = \frac{24 \cdot 10^6}{0.25 \cdot 1.613 \cdot 10^3} \approx 60.000 \text{ ac-ft}$$

Figure IX-5 shows graphically the acreage required for various depths of fills. The presently available acreage was determined earlier (interim report, Volume II) and amounts to 420 acres. The figure merely indicates the order of magnitude of the land required for landfilling operations if different densities and fill depths are assumed.

2. Required Composting Acreages

a. Total Waste Loads Processed by Composting

Earlier paragraphs of this section have discussed composting, dealing with carbon-nitrogen ratios and the amount of refuse required for composting. It was reported that by the year 2000, approximately 2, 276, 500 tons per year of mixed material will be processed by this method if the selected system is implemented. The mixed material consists of 1, 819, 950 tons per year

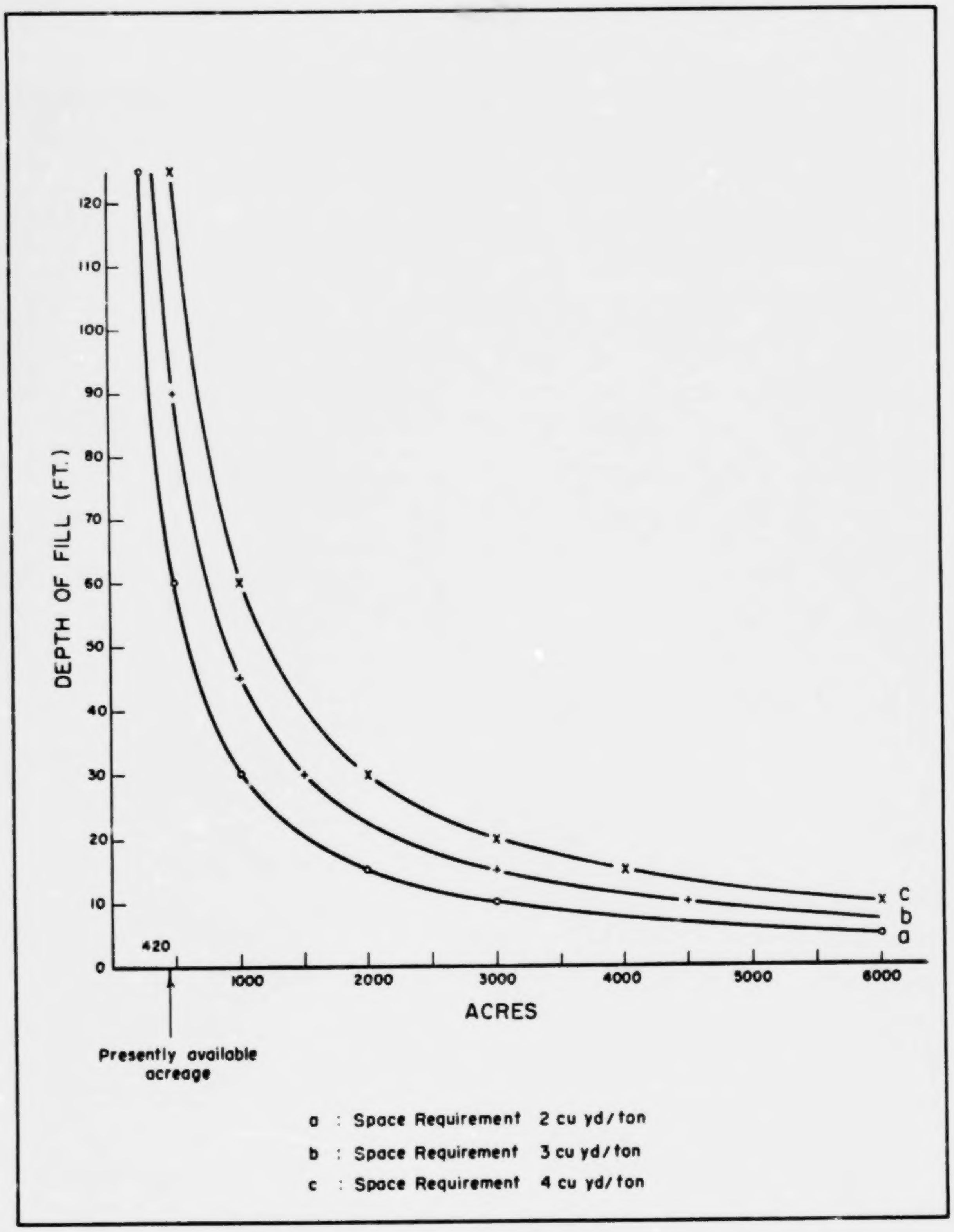


Figure IX-5. Sanitary Landfall Acreage - Depth Curves

of manure and 456,800 tons per year of municipal refuse. Throughout the thirty year period, from 1970 to 2000, the amount of municipal refuse diverted to composting operations to maintain the proper C/N ratios will depend upon the quantities of manure available for composting. As mentioned previously, it is not anticipated that any municipal waste will be used for composting in 1970, but by the year 2000, 456,800 tons per year would need be utilized.

The amount of municipal refuse required to satisfy the planned composting of manures and the total waste diverted to compost would be as shown in Table IX-3.

Table IX-3

WASTE LOADS PROCESSED BY COMPOSTING

Year	Manure	Quantities (tons/year) Municipal Wastes	Total Wastes
1970	0	0	0
1980	605,000	152,000	757,000
1990	1,200,000	305,000	1,505,000
2000	1,819,950	456,800	2,276,750

b. Compost Plant Site Area

It was reported earlier that by the year 2000 the waste amount of 2,276,750 tons per year would amount to approximately 1,143,000 tons per year of usable compost and that the maximum plant process capacity would be 8,750 tons per day to satisfy the total projected annual amount. A search of literature on compost operations indicates that mechanical composting plants of 400-ton/day capacity require about five acres. There is no definitive information on maximum useful plant size for compost production. From Table IX-3 it is apparent that by 1980 almost 2,400 tons/day (6-day week) should be processed. Whether 6-400 ton, 4-600 ton, 3-800 ton, 2-1,200 ton, or 1-2,400 ton/day plant is used will depend on economic optimization including plant operations, collection methods, and haul distances.

3. Recommended Compost Users

It must be realized that large scale composting is relatively new in this country. Potential compost users will have to be educated and it has to be shown to the public that widespread use of compost is beneficial. Early production should be used for governmental needs and it is recommended that this compost application would be carried out on the basis of a demonstration program.

It was enumerated earlier that approximately 15,400 acres will be needed by the year 2000 to satisfy the disposal requirements of the projected compost production. The following section will discuss some aspects of the benefit of using compost and list some potential users.

a. Governmental Use

Parks, municipal golf courses and areas of some rights-of-way represent the major places where compost can be initially applied.

It has been reported in the interim report that about 3,000 acres will be available for recreational purposes in 1985 and approximately 4,000 acres in 1990. Rights-of-way on the freeways and highways provide an acreage of approximately 1 acre/mile if the unpaved area is assumed to be about 8 feet.

Governmental use of compost could absorb a very significant amount of the total compost production and it is, therefore, stressed again that the introduction of the compost use program should start with governmental use.

b. Land Reclamation

Humus layers can be developed on presently unproductive land when compost is applied repeatedly to such land. Practice in Holland and Israel has shown that unproductive land can be converted to highly productive land in a time period of five to ten years. Such use has great potential in the study area, particularly since vast areas of presently unuseable, saline land exists to the west, within reasonable haul distance.

c. Forestry

Compost is quite useful for the restoration of topsoils which have been eroded or otherwise damaged by brush or forest fires. This use could also be classified as soil conservation which has the same purpose, that of restoring and conserving topsoils. Application rates could be from 80 to 120 tons per acre.

d. Orchards

Because orchards are a single crop, long-term agricultural activity, the topsoil of the orchards is repeatedly being compacted by heavy vehicles and other traffic during their lifespan. Application of 50 to 100 tons per acre of compost will not only improve the porosity of the soil but will also restore a nutrient equilibirum in the soil. Such use of compost would have a great potential in this area.

e. Vineyards

Like orchards, the soil of vineyards needs the addition of a material to improve its porosity. In addition, vineyards are subject to soil erosion from winds and rain and application of compost of 20 to 60 tons per acre would help to combat erosion by improving the porosity and moisture holding capacity of the soil. Nutrient benefit would likewise result from such application.

f. General Agricultural Use

As top soil replacement and humus material for general agricultural use, compost would be beneficial and have many applications in the Study Area.

g. Miscellaneous Uses

There are numerous miscellaneous uses for compost which generally would require only small amounts of material for individual situations but when consideration is given to the multitudes of such individual situations, the magnitude of the potential requirement for compost is amplified. Some of these uses are:

(1) Sale to private homeowners in bags or bulk for use as humus in home gardens

(2) Nurseries

(3) Low-grade fuel

The overall quantities of compost that could ultimately be utilized by all of the enumerated users is difficult to estimate at the present time because of the unknown quantity of acceptance, but it is considered that compost has a great potential in the area.

F. LONG TERM PLAN

The objective of this section is to describe future conditions in the Fresno region as the proposed master plan is implemented. Other sections deal with organizational and financial goals which must be realized in order that the ultimate system will become a reality. This presentation assumes such programs are brought to completion on schedule and no undue delays occur.

1. System in the Year 2000

A previous section of this report presents the details of the system for the study area for the year 2000, if the selected system is adopted. This section contains a brief overview of all systems for comparative purposes. All parts of the study area will not be in automated service by the year 2000 but this fact is overlooked in this discussion. Fiscal constraints will prohibit the complete automation of extensive areas of low density. The discussion which follows presents the general concepts for each category of waste as it will be presented in the year 2000.

a. Municipal Wastes

Refuse produced in the residential-commercial areas of major communities in this study area would be stored in containers amenable to automated pickups, thus the vehicle which services these areas would be equipped with the necessary devices such that it simply stops at a collection point, evacuates the container and passes to the next collection point. The operation of this equipment will permit a significant reduction in the number of personnel required to staff the collection service and will add materially to the sanitation condition of source storage.

The loaded vehicle, as now planned, would take a large fraction of the refuse to a well-operated landfill where disposal would be accomplished quietly with little or no dust or noise nuisances. This will be accomplished with further development of methodology and equipment used at landfill sites. The balance of the refuse, as selected by characterizing loads from particular areas with respect to compatibility with the composting of manures would be transported to a composting plant for processing prior to final disposal as a soil conditioner and supplier of trace minerals. Those materials which are non-compostable would be transported from the composting plant to the landfill for ultimate disposal.

Automated collection may not turn out to be exactly as described above, since additional waste processing methods may be involved; however, in the light of today's technology this appears to be the most likely ultimate program. A later section of this report deals with modifications which may come about with changes in technology and public attitudes.

b. Industrial Waste

Since industrial wastes are highly specialized and relatively small in quantity it is planned that these wastes will be stored in closed containers capable of automated collection at the source for vehicular transport to the landfill for final disposal. In some cases this is the current practice, but in many instances good controlled source storage is lacking and esthetically objectionable conditions often result; particularly in the case of putrescibles.

Organic industrial wastes (cannery wastes) would be processed by on-site composting. A portion of the compost produced by the municipal refuse-manure composting operation will be required for use as C/N ratio control and as a dry absorbent for wet wastes.

c. Agricultural Wastes

The future of Fresno appears to include a very large cattle feeding industry; hence, the rate of production of manures from this industry and dairying places a large burden on the environment. In the year 2000 these manures would be combined with refuse materials high in carbohydrates shifting the balance of the carbon nitrogen ratio such that the production of high quality compost is feasible. Efficient feedlot cleaning and closed trucking to the compost plant will eliminate many present problems of odors and flies. After the composting process is complete the product will be relatively stable; hence, it will be possible to store the composted manures during the non-growing season. This will also do much to relieve the often serious fly problem created by the management of these manures.

2. Immediate Actions

A single region-wide authority, such as the County, or a combination of County and Cities through joint exercise of power agreements, should be responsible for the waste management in the study area. The authority should have sufficient power to adopt and enforce regulations concerning waste management. Legal organizational aspects of such an authority are discussed in part G of this chapter. Among the first technical activities of the recommended authority should be the following:

a. Municipal Wastes

Develop detailed plans for phasing out old and opening new landfills. This effort should be coordinated with other land use planning agencies.

Adapt and enfore stringent standards for the operation of present and future landfills.

Perform a test program for the recommended collection system and build a pilot scale operation in a suitable area. (The financial needs for this program might be obtainable through the solid wastes program, U.S.P.H.S., Department of H.E.W. on a demonstration basis.) The preliminary design studies would serve as the basis for an application to the Federal Solid Wastes Program.

b. Industrial Wastes

Set up operation requirements for industrial incinerators. Continue the studies carried out by the National Canners Association with the objective of improvement of the NCA composting process for cannery wastes.

c. Agricultural Wastes

Perform pilot-scale composting operations for the combined processing of manures and refuse. Perform studies on storage and collection of manures at their source.

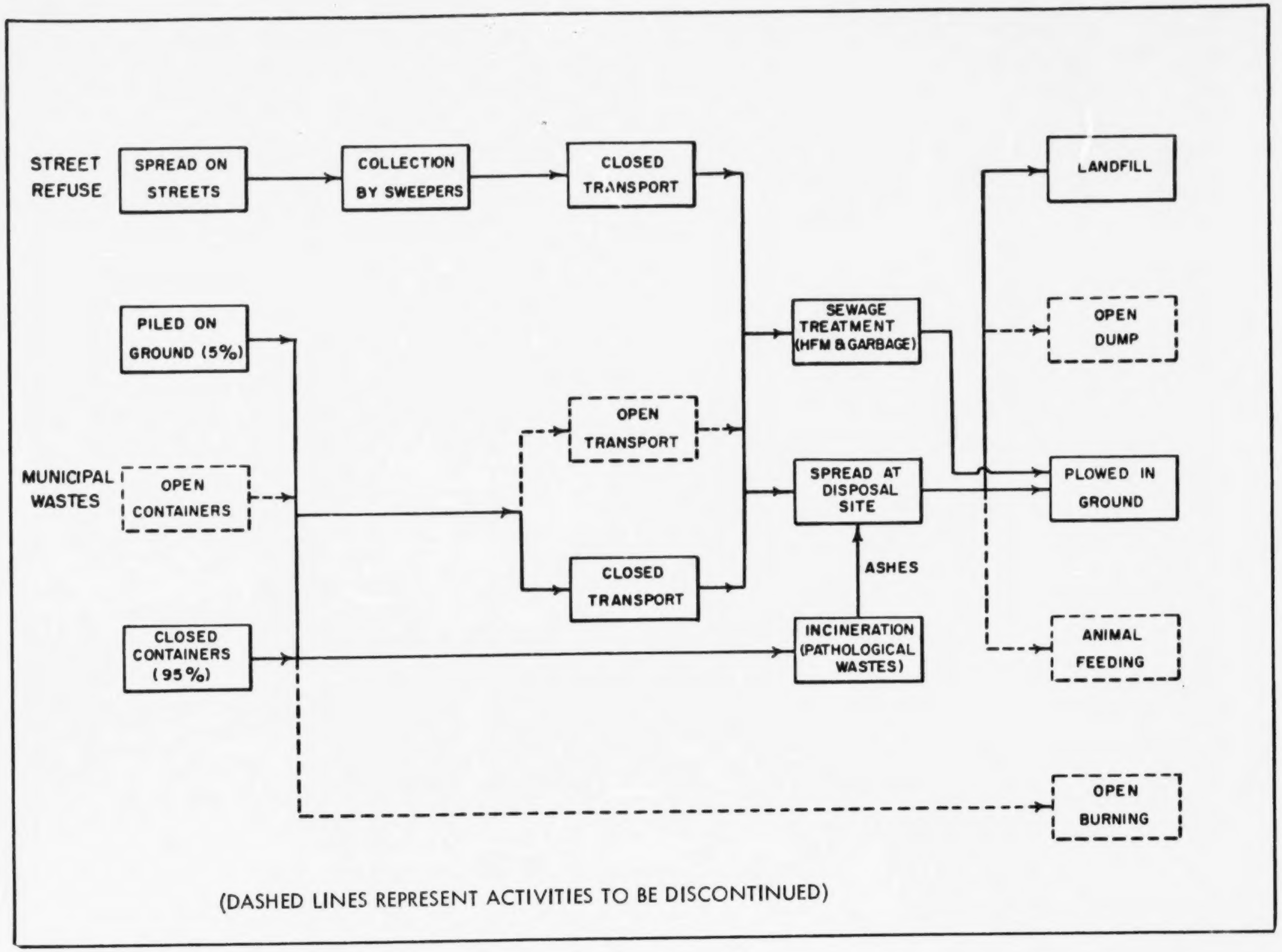
d. Compost Use

Set up a program for the development of a compost market in the study region. This program should include orientation and education of the public about the beneficial uses of compost. Use of compost in parks and on green belts of highways would demonstrate the benefits in a convincing way. The potential for reclaiming presently unuseable land should be explored.

e. Immediate Improvement of Existing Waste Management System

The improvements of the existing system are shown in Figures IX-6, IX-7, and IX-8. The figures show the existing system; however, those parts of the system that should be abandoned immediately are presented in dashed lines. A brief summary of all immediate improvements includes the following:

- No storage of wastes in open containers
- Closed transport of all wastes in the entire system
- Disposal of wastes by method of sanitary landfilling instead of dumping
- Abandonment of open burning of agricultural and industrial wastes


STREET REFUSE
SPREAD ON STREETS
COLLECTION BY SWEEPERS
CLOSED TRANSPORT
PILED ON GROUND (5%)
MUNICIPAL WASTES
OPEN CONTAINERS
CLOSED CONTAINERS (95%)
OPEN TRANSPORT
CLOSED TRANSPORT
SEWAGE TREATMENT (HFM & GARBAGE)
SPREAD AT DISPOSAL SITE
ASHES
INCINERATION (PATHOLOGICAL WASTES)
LANDFILL
OPEN DUMP
PLOWED IN GROUND
ANIMAL FEEDING
OPEN BURNING

(DASHED LINES REPRESENT ACTIVITIES TO BE DISCONTINUED)

Figure IX-6. Management of Municipal Solid Wastes (Immediate Improvement of Existing System)

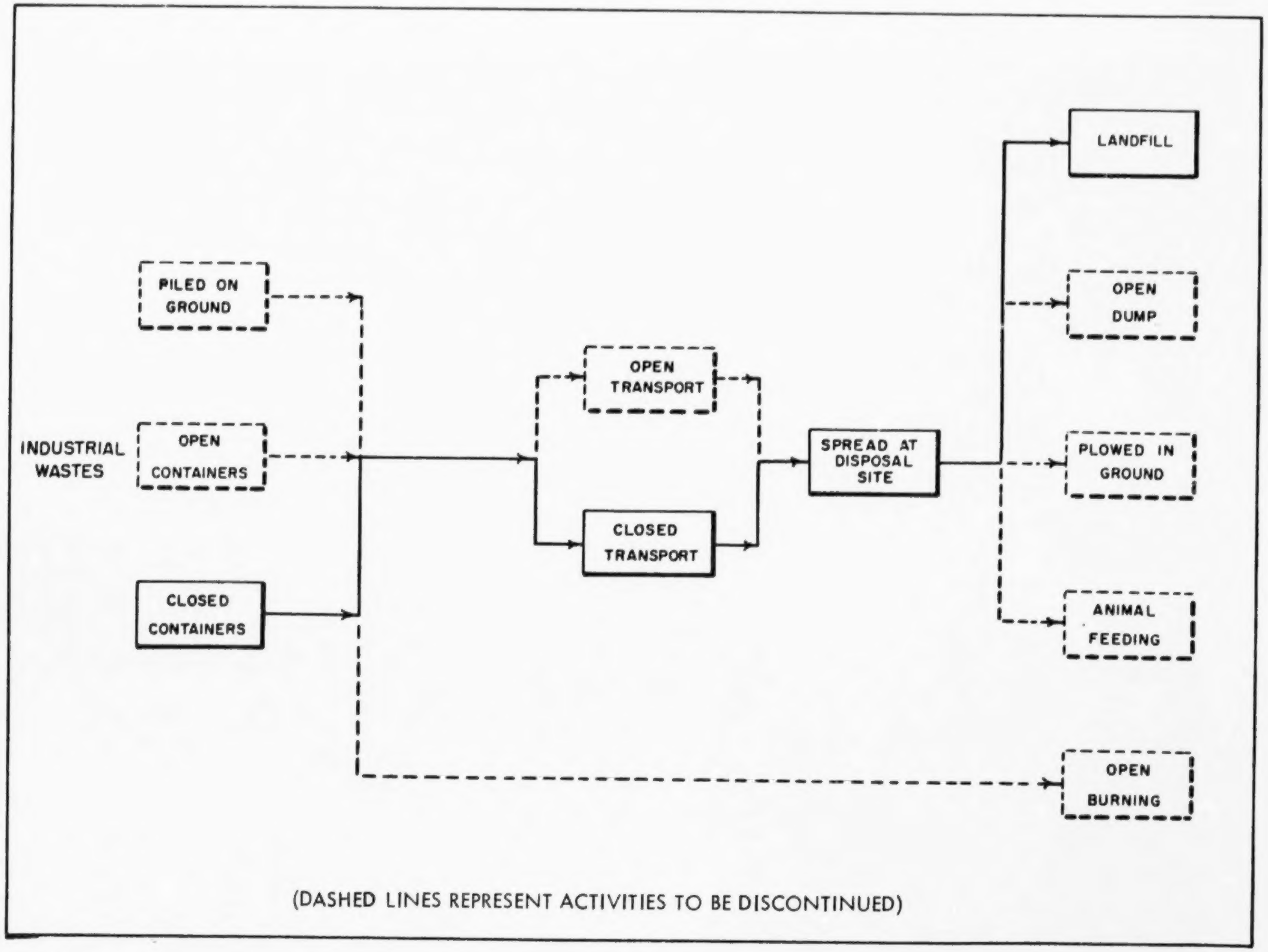
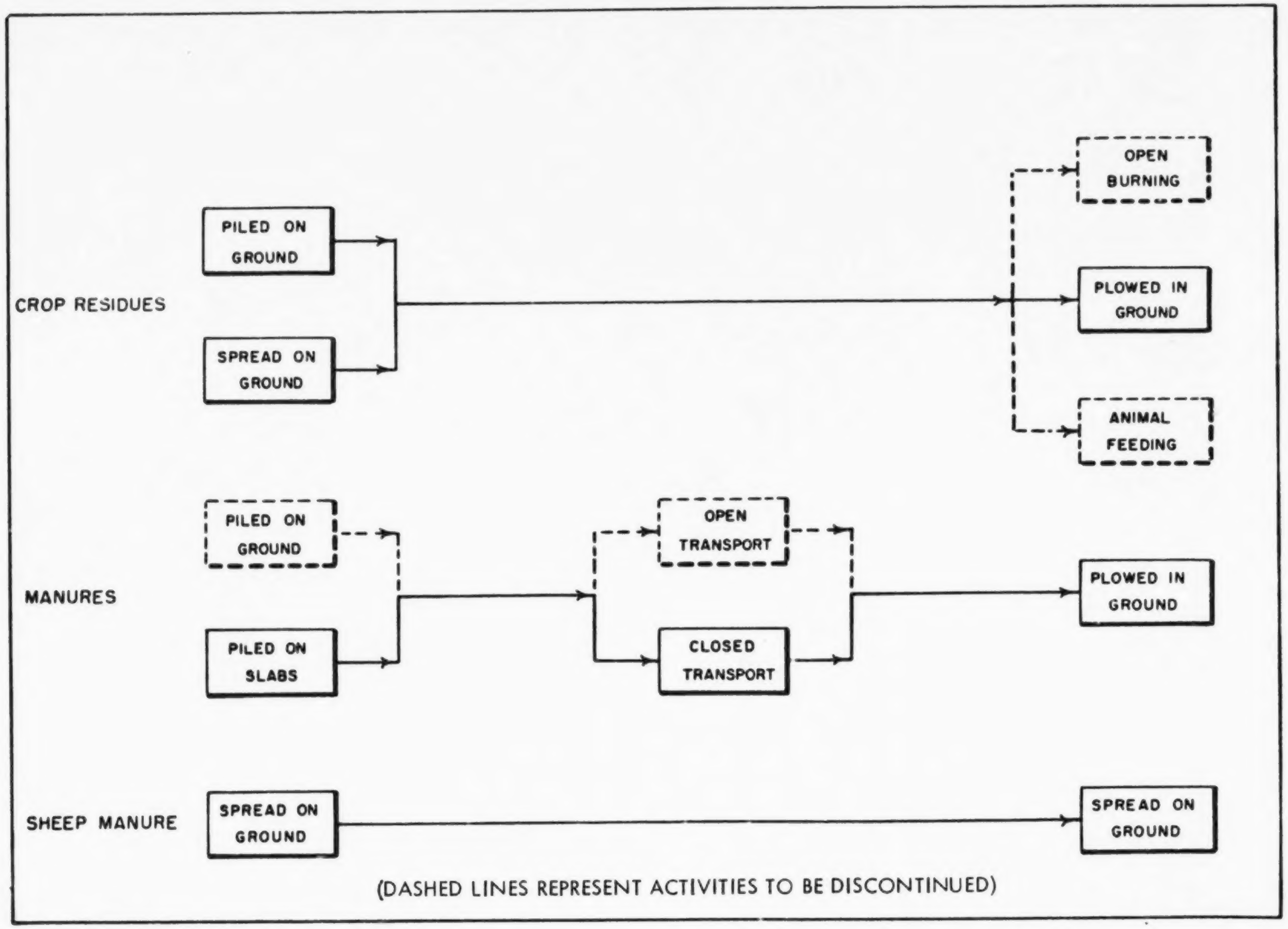

INDUSTRIAL WASTES
PILED ON GROUND
OPEN CONTAINERS
CLOSED CONTAINERS
OPEN TRANSPORT
CLOSED TRANSPORT
SPREAD AT DISPOSAL SITE
LANDFILL
OPEN DUMP
PLOWED IN GROUND
ANIMAL FEEDING
OPEN BURNING
(DASHED LINES REPRESENT ACTIVITIES TO BE DISCONTINUED)

Figure IX-7. Management of Industrial Solid Wastes (Immediate Improvement of Existing System)


CROP RESIDUES
PILED ON GROUND
SPREAD ON GROUND
OPEN BURNING
PLOWED IN GROUND
ANIMAL FEEDING
MANURES
PILED ON GROUND
PILED ON SLABS
OPEN TRANSPORT
CLOSED TRANSPORT
PLOWED IN GROUND
SHEEP MANURE
SPREAD ON GROUND
SPREAD ON GROUND

(DASHED LINES REPRESENT ACTIVITIES TO BE DISCONTINUED)

Figure IX-8. Management of Agricultural Solid Wastes (Immediate Improvement of Existing System)

3. System in the Year 1980

The anticipated system for the year 1980 is shown in Figure IX-9. The 1980 system is an intermediate step in the implementation of the selected system. The major waste categories are discussed in the following paragraphs

a. Municipal Wastes

By this time about one-fourth of the municipal refuse would be stored in underground conduits and be collected by trucks equipped with storage evacuators. This storage and collection system would be used together with conventional waste handling. High-density areas would be equipped with the tube storage system and some new subdivisions would have this feature too. About one-fourth of the collected municipal refuse would be composted in combination with about half of the total load of manures. The required composting capacities will be around 2,400 tons/day (6-day week). The production of compost will amount to approximately 380,000 tons/year.

Landfilling practices would be optimized. There would be fewer sites than at present and they will be nuisance free. This can be accomplished by stringent control and the use of adequate equipment designed for optimized community landfilling.

b. Industrial Wastes

Approximately half of the total amount of organic industrial wastes would be processed by the NCA or similar composting process. This requires about 20 percent (76,000 tons) of the total annual compost production to be used as an absorbent in the NCA process. The remaining 50 percent of the organic industrial wastes would be disposed of by sanitary landfilling.

Combustible industrial wastes would be processed in on-site incinerators which will meet air pollution control regulations.

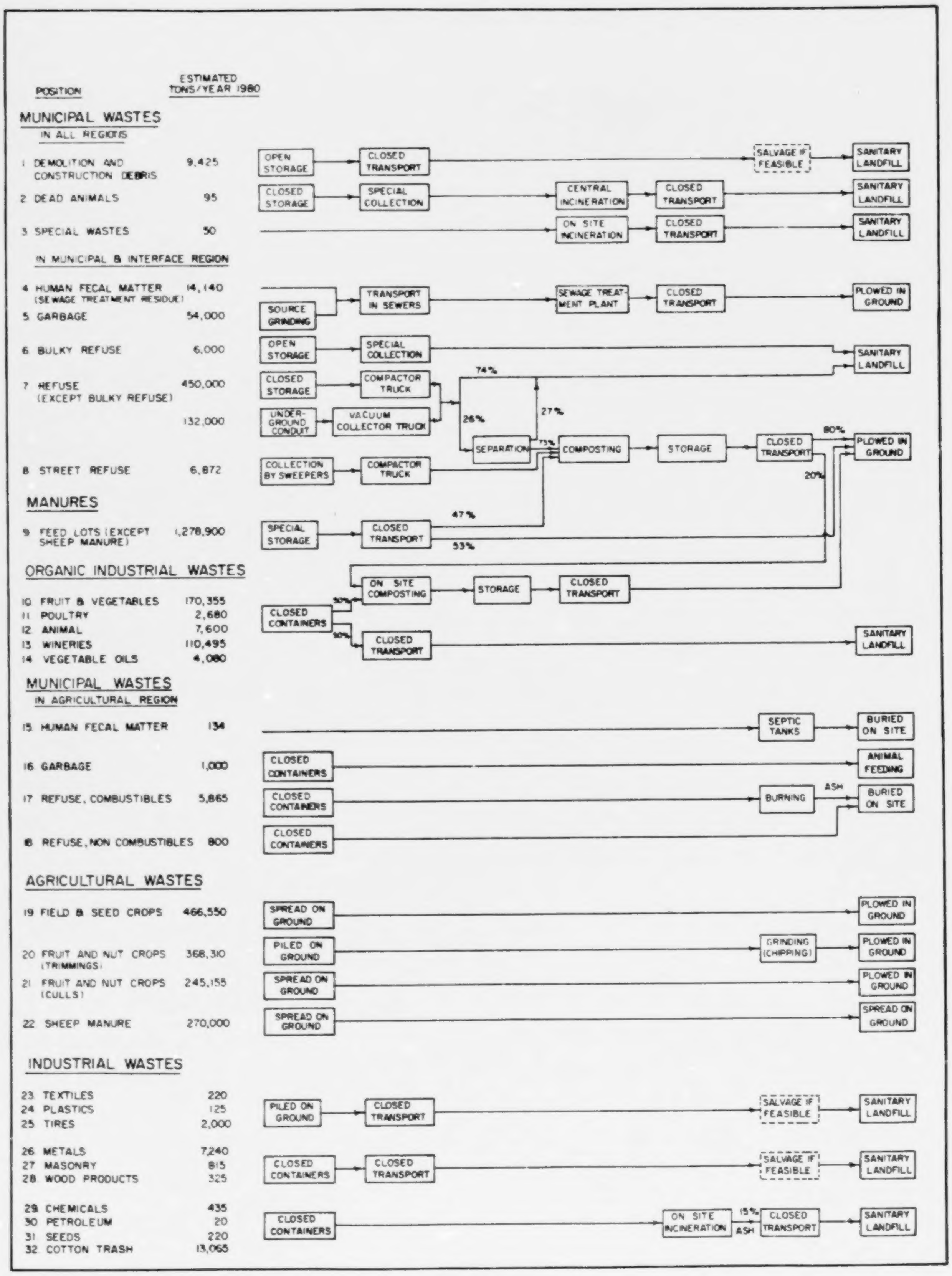

POSITION
ESTIMATED TONS/YEAR 1980
MUNICIPAL WASTES
IN ALL REGIONS
1 DEMOLITION AND CONSTRUCTION DEBRIS 9,425
OPEN STORAGE
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
2 DEAD ANIMALS 95
CLOSED STORAGE
SPECIAL COLLECTION
CENTRAL INCINERATION
CLOSED TRANSPORT
SANITARY LANDFILL
3 SPECIAL WASTES 50
ON SITE INCINERATION
CLOSED TRANSPORT
SANITARY LANDFILL
IN MUNICIPAL & INTERFACE REGION
4 HUMAN FECAL MATTER (SEWAGE TREATMENT RESIDUE) 14,140
5 GARBAGE 54,000
SOURCE GRINDING
TRANSPORT IN SEWERS
SEWAGE TREATMENT PLANT
CLOSED TRANSPORT
PLOWED IN GROUND
6 BULKY REFUSE 6,000
OPEN STORAGE
SPECIAL COLLECTION
SANITARY LANDFILL
7 REFUSE (EXCEPT BULKY REFUSE) 450,000
CLOSED STORAGE
COMPACTOR TRUCK
132,000
UNDER-GROUND CONDUIT
VACUUM COLLECTOR TRUCK
74%
26%
27%
SEPARATION
73%
COMPOSTING
STORAGE
CLOSED TRANSPORT
80%
20%
PLOWED IN GROUND
8 STREET REFUSE 6,872
COLLECTION BY SWEEPERS
COMPACTOR TRUCK
MANURES
9 FEED LOTS (EXCEPT SHEEP MANURE) 1,278,900
SPECIAL STORAGE
CLOSED TRANSPORT
47%
53%
ORGANIC INDUSTRIAL WASTES
10 FRUIT & VEGETABLES 170,355
11 POULTRY 2,680
12 ANIMAL 7,600
13 WINERIES 110,495
14 VEGETABLE OILS 4,080
CLOSED CONTAINERS
50%
ON SITE COMPOSTING
STORAGE
CLOSED TRANSPORT
50%
CLOSED TRANSPORT
SANITARY LANDFILL
MUNICIPAL WASTES
IN AGRICULTURAL REGION
15 HUMAN FECAL MATTER 134
SEPTIC TANKS
BURIED ON SITE
16 GARBAGE 1,000
CLOSED CONTAINERS
ANIMAL FEEDING
17 REFUSE, COMBUSTIBLES 5,865
CLOSED CONTAINERS
BURNING
ASH
BURIED ON SITE
18 REFUSE, NON COMBUSTIBLES 800
CLOSED CONTAINERS
AGRICULTURAL WASTES
19 FIELD & SEED CROPS 466,550
SPREAD ON GROUND
PLOWED IN GROUND
20 FRUIT AND NUT CROPS (TRIMMINGS) 368,310
PILED ON GROUND
GRINDING (CHIPPING)
PLOWED IN GROUND
21 FRUIT AND NUT CROPS (CULLS) 245,155
SPREAD ON GROUND
PLOWED IN GROUND
22 SHEEP MANURE 270,000
SPREAD ON GROUND
SPREAD ON GROUND
INDUSTRIAL WASTES
23 TEXTILES 220
24 PLASTICS 125
25 TIRES 2,000
PILED ON GROUND
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
26 METALS 7,240
27 MASONRY 815
28 WOOD PRODUCTS 325
CLOSED CONTAINERS
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
29 CHEMICALS 435
30 PETROLEUM 20
31 SEEDS 220
32 COTTON TRASH 13,065
CLOSED CONTAINERS
ON SITE INCINERATION
15%
ASH
CLOSED TRANSPORT
SANITARY LANDFILL

Figure IX-9. Proposed Solid Waste Management System
(Fresno Region, Year 1980)

c. Agricultural Wastes

It is anticipated that the completion of construction of a full-size compost plant(s) would occur about this time and that the market for compost will be developed, based on the experience with the pilot plant. The market of compost should fully develop between 1980 and 1990. Production of compost will amount to about 380,000 tons per year. Assuming an application rate of 75 tons/acre, the required area is

$$\frac{380,000}{75} = 5,200 \text{ acres}$$

or 8.1 square miles

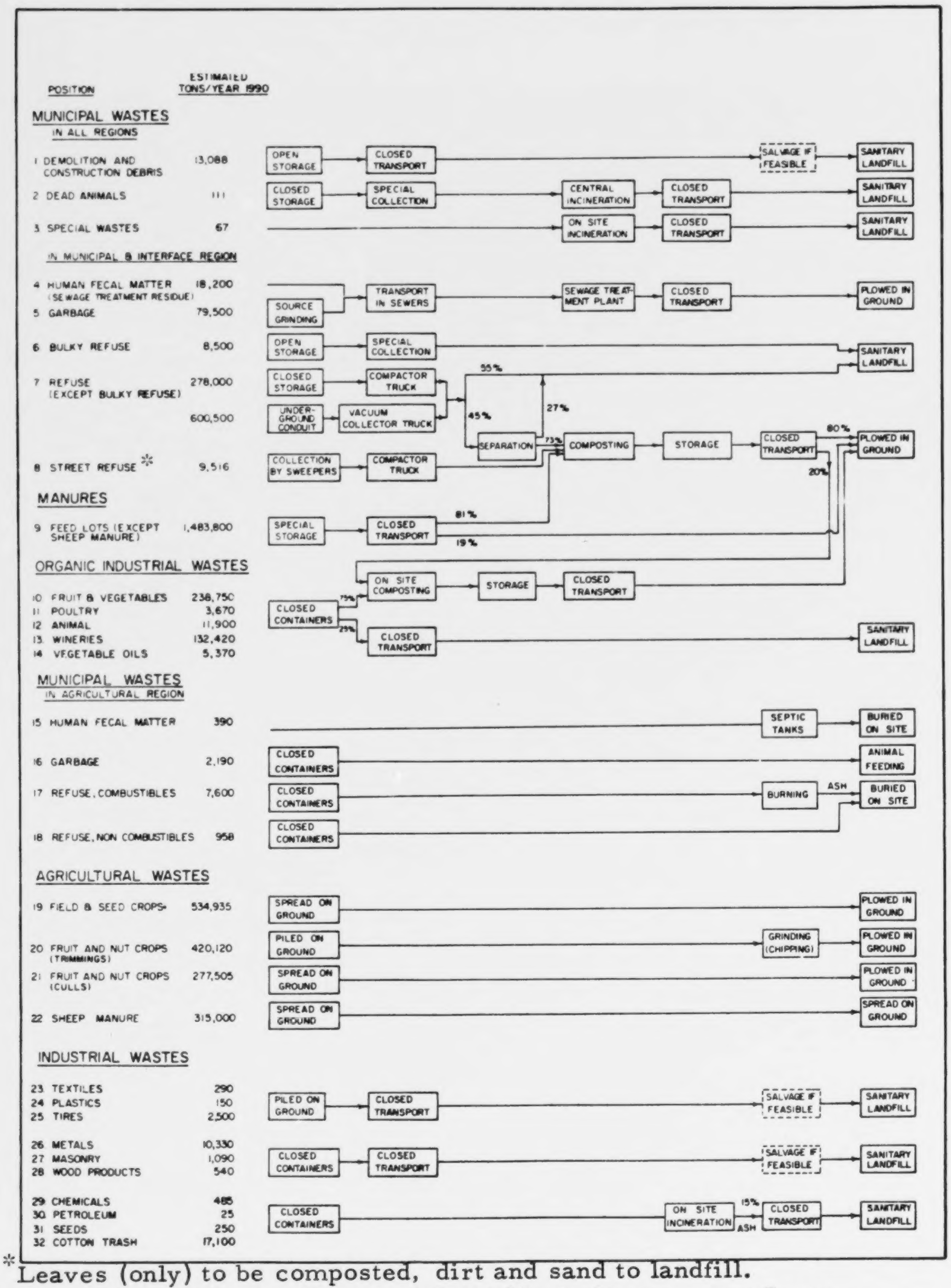
This acreage will be available through governmental use of compost.

4. System in the Year 1990

The anticipated system for the year 1990 is shown in Figure IX-10. The 1990 system is also an intermediate step in the implementation of the selected system. The major waste categories are discussed in the following paragraphs.

a. Municipal Wastes

By this time most of the high-density areas would be equipped with the tube storage system and many residences would also be so equipped, particularly in new subdivisions. The recommended collection system will be considered as a special modern convenience and an inducement to purchase; hence, builders will tend to install the system with the new homes. Approximately two-thirds of the municipal refuse would be stored and collected by the recommended system. Of the collected refuse about 45 percent would be processed by composting. The balance of the refuse, as selected by characterizing loads from particular areas with respect to compatibility with the composting of manures, would be transported to well operated landfills.


POSITION
ESTIMATED TONS/YEAR 1990
MUNICIPAL WASTES
IN ALL REGIONS
1 DEMOLITION AND CONSTRUCTION DEBRIS 13,088
2 DEAD ANIMALS 111
3 SPECIAL WASTES 67
IN MUNICIPAL & INTERFACE REGION
4 HUMAN FECAL MATTER (SEWAGE TREATMENT RESIDUE) 18,200
5 GARBAGE 79,500
6 BULKY REFUSE 8,500
7 REFUSE (EXCEPT BULKY REFUSE) 278,000
600,500
8 STREET REFUSE * 9,516
MANURES
9 FEED LOTS (EXCEPT SHEEP MANURE) 1,483,800
ORGANIC INDUSTRIAL WASTES
10 FRUIT & VEGETABLES 238,750
11 POULTRY 3,670
12 ANIMAL 11,900
13 WINERIES 132,420
14 VEGETABLE OILS 5,370
MUNICIPAL WASTES
IN AGRICULTURAL REGION
15 HUMAN FECAL MATTER 390
16 GARBAGE 2,190
17 REFUSE, COMBUSTIBLES 7,600
18 REFUSE, NON COMBUSTIBLES 958
AGRICULTURAL WASTES
19 FIELD & SEED CROPS 534,935
20 FRUIT AND NUT CROPS (TRIMMINGS) 420,120
21 FRUIT AND NUT CROPS (CULLS) 277,505
22 SHEEP MANURE 315,000
INDUSTRIAL WASTES
23 TEXTILES 290
24 PLASTICS 150
25 TIRES 2,500
26 METALS 10,330
27 MASONRY 1,090
28 WOOD PRODUCTS 540
29 CHEMICALS 485
30 PETROLEUM 25
31 SEEDS 250
32 COTTON TRASH 17,100
OPEN STORAGE
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
CLOSED STORAGE
SPECIAL COLLECTION
CENTRAL INCINERATION
CLOSED TRANSPORT
SANITARY LANDFILL
ON SITE INCINERATION
CLOSED TRANSPORT
SANITARY LANDFILL
SOURCE GRINDING
TRANSPORT IN SEWERS
SEWAGE TREATMENT PLANT
CLOSED TRANSPORT
PLOWED IN GROUND
OPEN STORAGE
SPECIAL COLLECTION
SANITARY LANDFILL
CLOSED STORAGE
COMPACTOR TRUCK
55%
UNDER-GROUND CONDUIT
VACUUM COLLECTOR TRUCK
45%
27%
SEPARATION
73%
COMPOSTING
STORAGE
CLOSED TRANSPORT
80%
PLOWED IN GROUND
20%
COLLECTION BY SWEEPERS
COMPACTOR TRUCK
SPECIAL STORAGE
CLOSED TRANSPORT
81%
19%
ON SITE COMPOSTING
STORAGE
CLOSED TRANSPORT
CLOSED CONTAINERS
75%
25%
CLOSED TRANSPORT
SANITARY LANDFILL
SEPTIC TANKS
BURIED ON SITE
CLOSED CONTAINERS
ANIMAL FEEDING
CLOSED CONTAINERS
BURNING
ASH
BURIED ON SITE
CLOSED CONTAINERS
SPREAD ON GROUND
PLOWED IN GROUND
PILED ON GROUND
GRINDING (CHIPPING)
PLOWED IN GROUND
SPREAD ON GROUND
PLOWED IN GROUND
SPREAD ON GROUND
SPREAD ON GROUND
PILED ON GROUND
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
CLOSED CONTAINERS
CLOSED TRANSPORT
SALVAGE IF FEASIBLE
SANITARY LANDFILL
CLOSED CONTAINERS
ON SITE INCINERATION
15%
ASH
CLOSED TRANSPORT
SANITARY LANDFILL

* Leaves (only) to be composted, dirt and sand to landfill.

Figure IX-10. Proposed Solid Waste Management System (Fresno Region, Year 1990)

The required composting capacities would be around 4,500 tons/day and the production of compost would amount to approximately 800,000 tons/year.

b. Industrial Wastes

Approximately 75 percent of the total amount of organic industrial wastes would be processed by the NCA or similar composting process. This requires about 20 percent (160,000 tons) of the total annual compost production (800,000 tons) to be used as an absorbent in the NCA process. The remaining 25 percent of the organic industrial wastes would be disposed of by sanitary landfilling. Alternative salvage through the production of animal feed or chemical by-products such as alcohols may remove substantial quantities from the disposal cycle.

All combustible industrial wastes would be processed in on-site incinerators which will meet air pollution control regulations.

c. Agricultural Wastes

By 1990 it is anticipated that the market for compost will be fully developed and a good balance of production and uses will be functional. Storage and collection of manures would be optimized and the odor and fly problem will be reduced to a minimum. Crop residues would continue to be plowed into the ground or collected and composted or processed for salvage; trimmings would be processed by grinding (clipping).

G. ORGANIZATION AND FINANCING

1. Introduction

The selected system, as described in this section, could be established in the region by the local jurisdictions within the existing organizational structure. The necessity for cooperation between existing overlapping governmental agencies could, however, result in piecemeal arrangements and actually prevent any meaningful realization of the stated goals. The pressures exerted on local officials to obtain the best for their particular community, occasionally makes such cooperative endeavors difficult to attain.

Appendix F, Volume III, of this report describes in detail the various organizational alternatives, within existing enabling legislation, available to any area in California. With such a wide scope of permissible governmental activity allowed by the enabling legislation, it is possible to describe an optimum organizational structure that includes majority desires while protecting minority rights. The organizational entity described below provides one possible method of meeting these objectives.

2. The Regional Approach

The objectives for any organization vary considerably when viewed by different segments of our society. The formation of a solid waste management entity, such as the one proposed, is no exception.

For example, from the standpoint of government the ideal administrative solution is one which approaches the structure of the public utility, with uniform administration and uniform rates and practices. From the standpoint of the private operator, the ideal situation is one in which he is endowed with vested rights in his enterprise, allowed a fair rate of return for his efforts, and in which he is protected from the unfair competition of others. From the standpoint of the citizen who receives the service, the ideal structure is one which guarantees to him equitable rate structures, uniformly acceptable service, and adequate recourse in case complaints arise.

To accomplish these objectives, the County-wide or regional system could be established by utilizing existing agencies, such as the County, by providing multi-agency cooperation through use of the Joint Exercise of Power Act, or by forming a special district. A brief description of one form of special distinct will serve to illustrate the types of regional systems that are needed to provide for integrated waste management systems.

This "district" solution may be adequately configured to achieve most of the benefits of total governmental control while allowing some participation by private enterprise and the involvement of private industry. Through this solution, the desired levels of uniformity, the economies of scale, and the elements of private entrepreneurial skills may be blended.

The desirability of representation on the district board by individual incorporated municipalities and unincorporated areas is great. Therefore, as a basic example, the sanitation district (Figure IX-11) is described. Such a district as that called for in this case does not presently exist in the form of enabling legislation. Only minor changes to existing legislation, however, would achieve the desired result. The powers and duties of the sanitation district require slight modification to provide for the following.

a. Reservation to municipal corporations, even though within the district, of the right to provide their own collection service.

b. Reservation to the district of the right to conduct collection and/or disposal operations in competition with private operators at reasonable rates.

c. Enfranchisement of private operators, if desired with concurrent vesting of some property rights and the imposition of rigid controls as to equipment, practices, etc.

d. Regional operation, either directly or by contract, of disposal sites in accordance with a detailed land development plan for providing parks, open areas, playgrounds, etc. Private operators would be required to utilize these disposal sites under the terms of and in the manner prescribed by their franchise agreements. In fact, operation of disposal sites might be the only function of such an organization, particularly in its formative stages. Under this approach, the conduct of solid waste collection and disposal activities would become essentially a private utility, operated by the district in and for the residents of the region and its included municipal corporations. While a great degree of flexibility would be accorded the district, its responsibilities are also proportionately greater.

The creation of such a district would undoubtedly require lengthly negotiations between cooperating local governments. If however, all concerned recognize from the start that the governing body will be composed of local elected representatives and not State-appointed officials, the task should be less difficult.

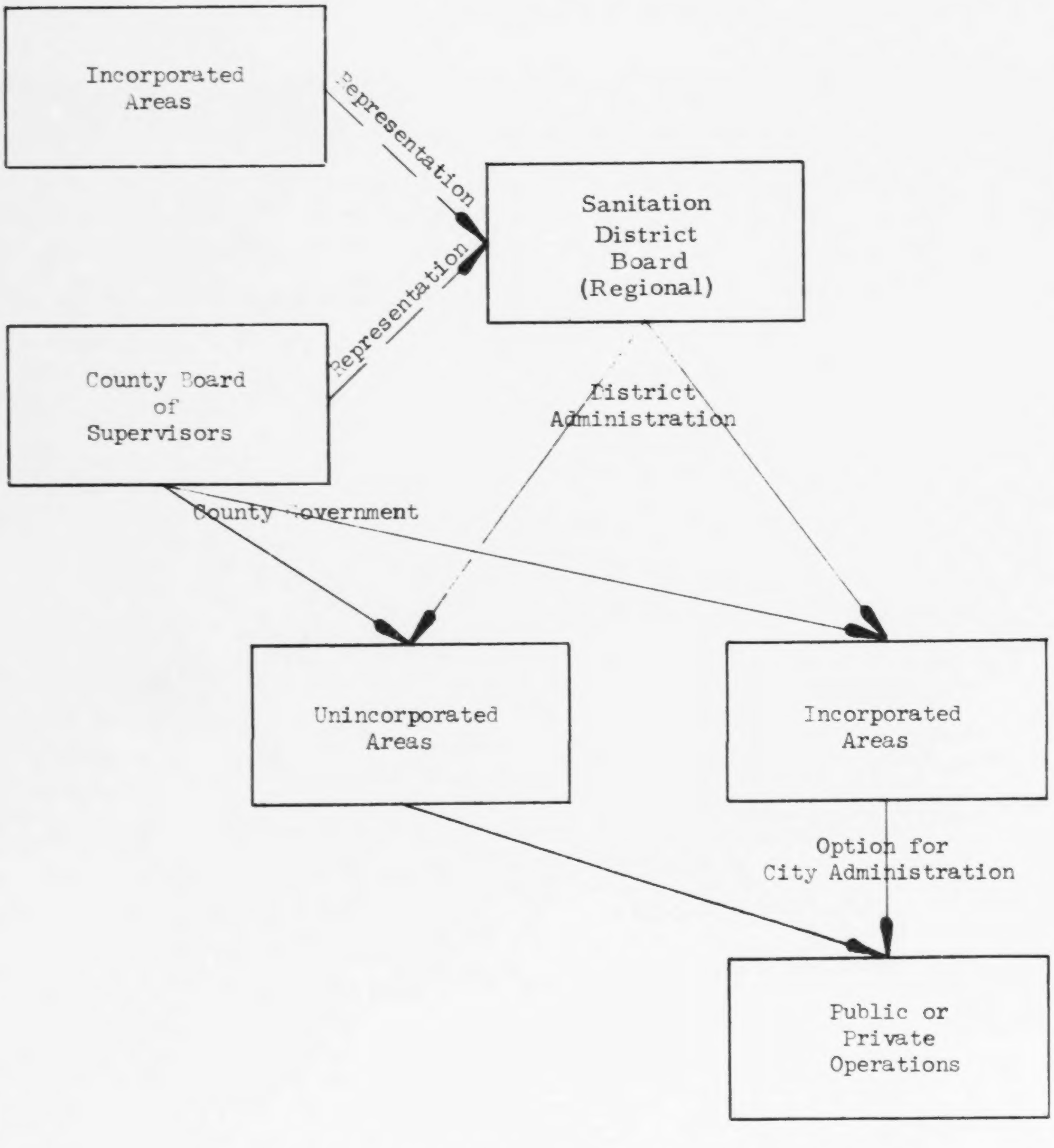

Incorporated Areas
Representation
Sanitation District Board (Regional)
Representation
County Board of Supervisors
District Administration
County Government
Unincorporated Areas
Incorporated Areas
Option for City Administration
Public or Private Operations

Figure IX-11. A Suggested Alternative Administrative Structure

The first task facing the district board, following its formation, would be a long-term planning activity. In conjunction with other agencies, the optimum long-range solid waste management system would need to be determined, rate structures and taxing base estimated, and operations implemented. In the case of the Fresno region, for which this organizational approach is specifically suggested, the approval by the district board of the system described in this section would accomplish the first step. It would be expected that the district, through its engineering staff, would maintain constant surveillance of operations to insure compliance with any franchise requirements, direct ultimate disposal activities, and recommend corrective actions to the board where necessary. The County Health Department should serve as the regulatory agency for district operations to insure operational conformance to county health requirements.

3. Financing

It is probable that any plan for improving the environment will be more costly. The money required, as indicated in Section VIII, will be approximately 78 million dollars, annually, by the year 2000. Each year, starting with the first increment of improvements will undoubtedly require additional expenditures in both capital and operating costs.

The sole source of revenue for financing solid waste collection and disposal services in the Fresno region has historically been the service charge. This method is barely self-sustaining in maintenance, operation, and replacement of equipment or sanitary landfilling sites. It is not likely that these revenues would service additional system implementation costs unless existing operational expenses could be drastically reduced. None of the existing public agencies within the study region have used, or even proposed to use, their existing legislative authority to produce revenues by property taxes, bonds, or any other form of indebtedness.

It would therefore appear that to successfully anticipate the availability of funds to implement new or imposed solid waste systems, new entities need to be created to make available a uniform system of funding, either as bond redemption or dept service funds. The bonding power of the proposed sanitation district could be utilized to obtain uniform and up-to-date equipment, capital improvements, and the conduct of operations under reasonable rate structures.

One of the most aggravating problems facing existing residents of any community is the continued need for the expansion of capital facilities during periods of population growth. With each new resident, the area is required to provide capital funds for additional police and fire protection, schools, recreational facilities, and now most urgently, pollution controls. The required facilities and personnel are needed immediately whereas the additional tax revenue contributed by the new residents does not nearly approach the immediate costs. The traditional solution to this dilemma is through bonded indebtedness and, where this fails, through increased taxes. A possible solution to this problem would be the creation of a "subdivision assessment" requiring that when each parcel of land is rezoned from agricultural to residential or from single family to multifamily residential use, a one-time tax be placed upon that land. The amount of tax would cover the pro rata cost of capital improvements needed for increased population, including solid waste management systems. New residents coming to the area would be placed on a "pay-as-you-go" basis. This approach is particularly effective in view of the projected increase in population for the region from 396,000 in 1967 to 1,056,000 by the year 2000.

Section VIII describes the increase in costs for the various categories of waste producers. From that description it is clear that dairies, feed lots, poultry raisers, and most industries will be affected to a greater extent than the municipal and purely agricultural categories. Since the manures and organic industrial wastes contribute such a large percentage of solid wastes of a highly putrescible nature, it seems only logical that the cost of improving the environment, caused by those wastes, be borne by the producers thereof. The realignment of costs, in accordance with the amounts produced and the associated environmental effects caused by those wastes, seems eminently equitable.

Federal financial assistance is available for certain portions of the proposed system; however, to retain maximum local authority it should be used commensurate with availability of local revenues for needed improvements. The following federal programs appear to be applicable:

a. Open Space Land Program

Fifty percent Federal grants are available from the Department of Housing and Urban Development for acquiring undeveloped and developed land suitable for permanent open space use. This is land for use as parks, recreation, conservation, scenic or historic purposes. For land acquired with open space grant assistance, fifty percent grants are also available for improvement

b. Urban Beautification and Improvement Program

This type of Federal grant, also financed by HUD, can be made to beautify publicly-owned or controlled land such as streets, parks, sidewalks, squares, and plazas. In this type of aid program, as in others, an overall beautification program consistent with local comprehensive planning must have been prepared and officially adopted by the requesting agency. A Federal grant for urban beautification may not exceed 50 percent of the amount the applicant increases expenditures for beautification activities above the preceding two years' average expenditure.

c. Solid Waste Disposal Facilities

The Solid Waste Disposal Act of 1965 provides money to communities to build pilot waste systems. Money, to this date, has not been provided for construction of complete operating systems. Congressional amendments were offered in April 1967, however, which would grant a community two-thirds of the cost of construction of solid waste disposal facilities and up to 75 percent of the construction cost of an implementation system to serve an area of more than one municipality. The amendments are still under consideration. Although it may be assumed that Federal funds will eventually be available, neither the amount nor the timing can be projected. Governmental agencies supplying subsidies such as described above, uniformly desire a single agency to supply the

the service and act as the recipient of such grants. This factor adds to the desirability of establishing the recommended organizational structure.

H. ALTERNATIVES

The following paragraphs describe possible alternatives to the proposed system should technological advances, economic upturns, or other reasons, justify further environmental improvements.

1. Pneumatic Collection System

The concept of a collection system of individual conduits served by a vacuum collection vehicle could readily be expanded to a central pneumatic collection system. Such systems would probably be developed initially for high density dwelling areas and business districts. Pneumatic collection systems for high-rise buildings and hospitals are currently in existence and can be considered as state-of-the-art.

The utilization of these systems for single family, low density areas would be contingent on the demand by society for ultimate environmental improvement, convenience, and the willingness to pay the higher costs for these types of systems (see Section VIII). Their use for high-rise apartments, hospitals and other commercial or institutional operations is appropriate with the proposed system concept.

2. Transport in Sewer Lines and Combined Sewage Treatment

The benefits of transportation of solid wastes via sewer lines have been discussed in detail in Chapter VII. If a liquid transportation system should be developed, the selected system could easily be adjusted to such a system with only minor changes. Wastes could be collected as planned, but the collected wastes could either be ground in the collector truck and discharged to the sewers immediately; or the collected wastes could be transported to centralized grinding stations (Systems 10-15, Section VIII). Ultimately, this material could be discharged directly to the sewers from home refuse grinders (Systems 7-9, Section VIII). Features of a combined collection and treatment system for solid and sanitary wastes would include: Steeper invert slopes of sewers in order to guarantee minimum velocities; increased use of pumping stations required by increased flow and by steeper slopes; recycling of transport liquid following minimal treatment; use of short retention time sedimentation at frequent intervals to remove inorganic settleables; increased sewage treatment facilities for screening, grit removal and comminution and increased capacities to handle significantly higher sludge loads. Future systems could also include transportation of manures and certain industrial wastes to sewage treatment plants via sewer systems. This method, although very convenient, would require additional sewage treatment facilities because the nutrient load (Nitrogen and Phosphorus) in the water would increase significantly. Again, the adoption of such a system implies society's demand for an optimum environment, added convenience, and acceptance of greater costs. Additionally, jurisdictional problems arise for this concept in that administrative entities responsible for liquid waste collection and treatment would become involved.

3. Incineration

Controlled incineration offers promise for additional improvement of the recommended system if the financial limits could be further expanded.

Combustible wastes that are disposed of by sanitary landfilling in the recommended system could be incinerated. A combination of composting and incineration is especially promising for the Study Region where manures are a dominating factor in the waste management system. This is common practice in Europe where almost every composting plant recently built includes an incinerator in the overall operation. Collected manures could be mixed with municipal wastes but could then go through the composting process or the incineration process. This would result in a highly flexible waste management system and seasonal changes in waste loadings and product market would have little effect.

I. DISCUSSION

1. Selected System Concept

Previous sections described how the presented system has been selected. It is fully recognized that composting as a waste disposal method has not been successful everywhere in this country. The following paragraphs indicate some distinctive differences between existing operations and the selected system.

Only about 50 percent of the municipal solid wastes will be composted, thus preliminary segregation is possible by selection of collection routes which may deliver their wastes to the composting plants.

The compost produced will be of high quality because manures represent almost two-thirds of the raw product entering the composting operation.

The system has been selected on the basis of long-term environmental engineering aspects and was not based on a momentary, profit-making waste disposal method.

Composting as a waste disposal method was recently discussed by Hart (Reference 7). He pointed out and noted that there is presently an important

> ". . . contrast in the attitudes of farmers in West Germany and the United States in relation to the use of compost and other organic refuse on agricultural soil. West Germany has today 56 million people living on 94, 500 square miles. With about 25 percent of the U.S. population and 3.2 percent of the land area of the U.S., West Germany produces 78 percent of its food supply. The average size of farm is but 24 acres, hence, productivity must be high. One factor in this productivity is intense use of barnyard manure, compost, and other organics, and German agricultural science has found that maintaining a high and constantly replenished soil organic content is one of the keys to continued high productivity. Thus the incentive exists for the farmer to route his agricultural residues back to the land and hence to prevent their becoming a part of the overall wastes management problems of the community.

The situation in the United States today is, of course, vastly different. We have plenty of prime agricultural land and are easily able to produce an abundance of food. Organic content of the soil does not have to be husbanded, although it seems desirable to do so in the western U.S. Thus the economic pressure for compost production from solid wastes does not arise in the U.S. from agriculture. In fact, the economics of U.S. agriculture tends to increase the volume of solid wastes which agriculture does not want in any form.

Nevertheless a significant lesson may be drawn from the German experience - i.e., it is possible to use the land and its ability to assimilate organic matter as a way of disposing of some of our solid wastes. While this is a relatively new approach to refuse management it does imply that if compost can be produced at an acceptable cost, agricultural land might be used instead of a landfill for its disposal. In this case the economics of refuse disposal rather than the economics of agricultural fertilization would become the controlling factor. Possibly the farmer might be paid for accepting compost rather than asked to purchase it.

Concerning the technology of composting several things can be learned from the West German experience. Eight plants erected since World War II continue in operation to the present. None have been shut down. The general characteristics of each are indicated in Table IX-4. It is notable that all are in or near the wine-growing areas of Germany. Further, seven of the eight include sewage sludge in their input.

Extensive research on the survival of pathogens in the composting process has been conducted. The results show that there is a minimum time-temperature condition required for pathogen kill. In windrow composting this was observed to be 18 to 21 days at temperatures consistently above 55°C. At lower temperatures some pathogens lived 251 days. In the Dano drum 5 days were required - or 3 days, plus 4 additional days in windrow storage. At Heidelberg, where the refuse is ground before putting it in the Multi-Bakter Turns, pathogens were killed within 24 hours. These results seem to be directly usable under U.S. conditions.

From observations in West Germany, Dr. Hart draws several conclusions which have pertinence to project work planned for the future at the University of California:

1. Sewage sludge disposal is an important factor in the reasoning behind composting. Sewage sludge disposal has generally been a difficult part of the water treatment process of Germany, and part of the burden for the management of the sludge seems to have been turned over to workers in the solid waste field. Composting is an efficient and effective method of sludge disposal.

2. Health and sanitation problems should not be a serious obstacle to compost use. Careful scientific studies on pathogen inactivation have been conducted in Germany, and both the results and the techniques of study are appropriate to the U. S. Safe compost can be produced.

3. The various composting processes produce equivalent quality compost at apparently equivalent cost. The quality of the compost and the cost of producing it is more a function of the amount of "cleaning up" of the material than of the nature of the raw material or the method of composting. The grinding, sieving, and separation can be done either before or after composting, but the higher quality compost is produced with some final sieving and separation. It also appears that there will be no great new economies due to new processes, although mechanical processes do save space over windrow composting. A high quality compost contains less inert or objectionable material (glass shards, plastic, and ash) than poor quality compost, and can more economically be transported greater distances. The economics of quality improvement and transport logistics has not been worked out but certainly should be done.

4. Compost has its greatest market on luxury crops. The discussion and the data in Table IX-4 indicate that most of the compost is produced in the wine-growing region of Germany and is used on the vineyards. It is significant that compost presently seems to have value only on the luxury crops, and not basic agricultural soils and crops. There are exceptions of course, such

Table IX-4

GERMAN COMPOSTING PLANTS

City and Plant Owner	Pop Served	Operation Begun	Sludge Accepted	Process	Net Cost to City per metric ton of raw waste accepted Compost Selling Price	Description of Operation
Baden-Baden City	56,000	1953	yes	Windrow composting of unground refuse	13.10 DM 10-12 DM/met ton	Magnetic iron removal plus hand separation, refuse mixed with sludge, and piled for 3-5 months without turning. An air-duct system for aerating the piles has not been effective. Finished compost is ground and sieved. Noncompostable residues burned if possible, and buried.
Bad Kreuznach Private, Farmers Organization	45,000	1958	yes	Dano drum without pre-grinding	10 DM 10 DM/met ton to Assoc. members	Magnetic iron removal, then unground refuse and sludge put in Dano drum for 3-4 days. Partially rotted compost is sieved, and piled in windrows without further turning. Oct-Dec disposal on grape land. Noncomposted sieve residue is buried on the site, thus raising the elevation of the storage area. Successful operation, mostly due to the demand for the compost.
Blaubeurin Private, Cement Manufacturer	20,000	1954	yes	Windrow composting of ground refuse	Estimate at 2 DM, seems low Set at 14.50 DM/ cubic meter for quarry reclamation	Plant was erected to produce compost to reclaim sand and gravel quarries. Hand separation of refuse possible but not always done, Dorr-Oliver rasp, then ground in hammer-mill, sludge added and windrowed. Three turning. Finished compost used "as-is," mostly for quarry reclamation. Small incinerator for bulky noncompostables.
Duisberg-Huckingen City	120,000	1956	yes	Dano drum without pre-grinding	5.20 DM, presently good salvage income 9-20 DM/met ton	Refuse from only part of Duisberg is processed. Magnetic and hand separation, then unground refuse and sewage sludge into Dano drum for 3-day detention. Discharge sieved. Sieve residues to landfill. City is planning an incinerator. Compost plant does not run continuously due to odors from Dano drum.
Heidelberg City	30,000	1955, 1962, see disc.	yes	Multi-Bakter Turn, with pre-ground refuse	Estimated at 5-7 DM 13 DM/cu meter to wholesaler who distributes	Refuse and sewage from 30,000 (personal estimate, city estimates 60,000) of area's 160,000 residents composted. Magnetic and hand separation, Dorr-Oliver rasp, sewage sludge added, and mix goes to Multi-Bakter Turn. 3-day detention (mechanism runs only 8 hours per day). Discharge sieved and ballistically separated, ready for immediate sale. Residues are landfilled.
Schweinfurt City	85,000	1963	yes	Caspari-Brikkolare, with pre-ground refuse	9.10 DM 17-20 DM/met ton	85,000 of the 120,000 residents of the area served. Magnetic separation, Dorr-Oliver rasp, ballistic separation, then the ground refuse plus sewage sludge is pressed into briquettes. Stored three weeks on pallets in a warehouse where composting occurs. Removed and stored outside until ground and sold. Incinerator then landfilling for residues not composted.
St. Georgen (near Freiburg) City	14,000	1963	yes	Windrow composting pre-ground refuse	33.50 DM, high due to small size and complete disposal by composting 13.50 DM/met ton	Smallest plant, but accepts total solid wastes from 2 communities and makes everything into compost. Magnetic and hand salvage, noncompostables burned and the ash returned to refuse which is ground and mixed with sewage sludge. Piled for 5 months, with 3 turnings. Not in continuous operation although equipment is large enough.
Stuttgart-Mohrigen City	75,000	1959	not now	Windrow composting pre-ground refuse	7.20 DM 5 DM/met ton, with only a portion sold	Only a part of the Stuttgart solid waste is made into compost, rest goes to landfill (with some incineration first). Magnetic and hand separation then rasp-sieved and ballistically separated. Placed in windrows, 2 turnings in 3 months' time.

Reference (7)

> as Blaubeurin, where reclamation of quarry-land is the prime use. But finding an appropriate and expanded market for compost will be a most significant factor for future success of any composting plant.
>
> 5. Research is needed on compost utilization. Most people - laymen and professionals together - wish that the composting situation were more favorable. It is not, but this does not mean that composting or composting research should be abandoned. In addition to using compost for luxury crops and land reclamation, composting is appropriate for sludge acceptance, for reduction of the volume of waste going into a landfill, and perhaps other reasons. (Organic material as a container for poisonous material such as pesticides is a possibility and should be investigated.)"

It could be added to these statements that the problem of sewage sludge disposal in the study region is less significant than the problem of manure disposal.

2. Liquid Transport

Transportation of solids via sewer lines provides significant benefits for the management of solid wastes. However, long-term water quality aspects should not be overlooked. Water reclamation will be one of the key factors in future water management plans for the Central Valley. Increased mineralization of water may become a dominating factor in resource management for a region which is predominantly dependent on agriculture and abundant water supply.

3. Incineration

Incineration is most promising in those situations where not only weight reduction but also volume reduction is a dominating factor in solid waste management. This does not apply for the study region presently but increasing costs for long distance haul or limited land availability may make incineration competitive with other waste management systems.

One of the major constraints in incineration is air pollution control. Removal of particulate matter is technically feasible today; however emission of incompletely burned hydrocarbons and nitrogen oxides may cause severe smog problems. There is little information available about gaseous pollutants from municipal incinerators.

The study region is located in an area where smog conditions (inversions) are very frequent, especially during the winter months.

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X. APPLICATION TO OTHER REGIONS

A. PURPOSE

This study has developed methodologies for evaluating environmental and sociological effects produced by solid waste management systems. The purpose of this section is to delineate how the system and data, developed in this study for the Fresno Region, can be applied to other similar regions in California and the Nation.

The application of the study methodologies to an area similar to the Fresno Region in geological and climatological conditions, population distribution and growth pattern, and agricultural, industrial, and commercial mix, would simply entail the use of the procedures previously outlined in this report. However, regions with the exact parameters outlined above are extremely rare and most practical applications would require adjustments to the procedures for evaluating effects and system costs due to the peculiarities of the region being evaluated. The following procedures, in general, will be necessary for the successful application of the study methodologies in the analysis of solid waste problems in other regions.

B. PROCEDURES

1. Regional Description

Application of procedures to evaluate the environmental effects of solid waste in a particular region requires data on regional geology, climate, population, economy and government as a necessary antecedent to system evaluation.

a. Physical and Environmental

The establishment of geographical limits for a particular study region or waste management area can have profound effects on both application methodology and the study results. The area proposed should ideally be large enough that waste handling systems are not limited by boundaries of small political subdivisions, yet not so large that the effects of management or mismanagement in one locality has little or no effect on other localities in the area.

The application program should consider the geophysical condition of the region in question, i.e., the extent of surface and subsurface water availability, usage, and replenishment systems; climate, including growing season for various crops; precipitation; wind patterns; and seasonal temperature expectations. Any special limitations on waste handling systems peculiar to the region in question, due to its location or due to existing physical or environmental conditions, should be delineated and the effect established.

b. Population Distribution and Projections

An important aspect in the application procedure for evaluating solid waste system effects is the current population, its distribution throughout the region, and the projection of population densities and land use patterns.

The amounts and character of solid wastes that must be handled by any proposed system is a direct result of the region's population pursuits. The seriousness of various environmental and sociological effects is also greatly influenced by the population densities and business interests. Population data is, thus, of crucial importance in the establishment of the evaluation procedure.

c. Economic Capacity and Projections

The strength of the regional economy is an important factor in the capability of the region to pay for and maintain systems of waste management with the least environmental effects. Furthermore, higher income areas desire and demand better management systems, both from the standpoint of environmental or bad effects and sociological or ancillary effects.

The economic endeavors of the region are important to the quantity and character of the wastes produced. Projections of the direction and extent of economic growth in the region help determine future waste loading characteristics.

d. Legal and Governmental Organizational Limitations

The existing laws and governmental relationships within a specific region have a decided effect on the extent to which solid waste has been properly managed or been allowed to become a nuisance.

The regional governmental organization, if sufficiently fragmented, can make the application of methodologies and controls to decrease bad effects difficult, while a responsible cooperating central authority or governmental council representing the various communities can almost insure success. Laws and controls must be established and maintained that will insure compliance with the requirements of the finally selected regional system of waste management.

An extremely important aspect in securing popular support is education. The community must be educated and informed as to how the various functions of any proposed waste management system will improve the general environment, so that the maximum voluntary cooperation of the general public can be obtained. It should be pointed out that the understanding and cooperation of persons in governmental administrative authority is even more important.

2. Waste Inventory

After the regional characteristics have been established, the next step in a regional solid waste management effort is the compilation of data for existing and projected waste loading.

a. Agricultural

The existing acreage for the various crops grown in the region should be established and, from the expected agricultural trends, crop acreage extensions or decreases determined. Crop residues, i.e., tons of waste per acre of crop harvested, have been established for the majority of crops grown in the Fresno region. Using the factors developed in the Fresno study on waste per acre of crop for similar crops in the proposed region, the total waste load from each crop can be calculated. Waste load factors for those crops not established in the Fresno study would need to be determined.

b. Industrial

The effort on economic capacity and projections will have established the existing industrial pattern as well as the expected future changes. From the existing and projected industrial capacity, the rate of production, quantities, and types of existing and future industrial solid wastes can be established. Those factors established by the Fresno study can be utilized, but they represent only a small fraction of the various industrial wastes found in other areas.

c. Municipal

The existing municipal solid waste loadings are calculated from the quantities and types of waste presently being generated while projections of these loadings must consider trends in population expansion, standard of living changes, and changes in food, food preparation, wrapping, clothing, housing, and recreation.

The population density has a decided effect on the degree to which the various bad effects of solid waste can be tolerated and, thus, is of extreme importance as a factor influencing the type of solid waste management system that will provide the necessary alleviation from solid waste environmental and sociological effects.

3. Application of Bad Effects Scores

a. Waste Conditions and Bad Effects

In this study, 82 different wastes were scored in 19 conditions for 13 environmental effects (bad effects). The basic bad effect scores, i.e., the scores without consideration of influence coefficients, for each unit quantity of waste in each condition can be used directly. If additional wastes and conditions in which the waste can appear are to be evaluated, the procedure described in Section IV, using experts to rate the wastes and conditions, should be followed.

b. Influence Coefficients

Regions large enough to make effective use of the methodologies developed in this study will be composed of subregions that are primarily municipal, others that are industrial, others that are agricultural, and still other subregions that, due to the proximity of municipal to agricultural areas, must be considered interface. This method of regional subdivision is used in the Fresno study.

Development of the influence coefficients for each subregion requires three discrete steps. First, the bad effects should be ranked by experts using the methodology suggested in this study of paired comparisons. Second, a statistical sampling of the general public should be conducted to rate the relative importance to society of the ranked bad effects. The third step involves the application, again by experts, of a relative contribution factor that relates the approximate contribution of solid wastes to each particular bad effect. The influence coefficients are, then, the normalized product of multiplying the bad effect rating times the contribution factor. The influence coefficients established for the subregions of the Fresno region are peculiar to that region and new influence coefficients should be established when the scoring system devised in this study is applied to any other region.

c. Total Weighted Bad Effects Scoring

The influence coefficient developed for each bad effect in each subregion is applied to the basic bad effects score for each solid waste in each possible condition. The resulting score for each waste in each condition is added for all bad effects, resulting in a listing of the total bad effects for a unit of each waste in any condition being considered for each subregion. This listing is the total weighted bad effects score that, when applied to the quantities of wastes in the different conditions for various proposed waste management systems, results in the system bad effects score by which different systems can be compared as to their efficacy in reducing environmental or bad effects.

4. Waste Handling Systems

A large number of different solid wastes are generated in any region large enough to include municipal, industrial, and agricultural subregions. Although systems can be evolved to reduce and minimize the bad effects from each individual waste, practical application requires the categorization of as many as possible of the individual wastes. In addition, for the study recommendations to be effective in a particular region, the practical aspects of current methods, habits, and cost must be thoroughly considered.

For example, to postulate a system in an agricultural zone requiring the collection and removal for processing of all field crop residues is patently impractical, since the costs involved would reduce the competitive position of the farmers in the region. On the other hand, a system such as home garbage grinding, while relatively expensive on a unit cost basis, is so convenient that any system eliminating the home grinders in a region where it has become the practice is likely to be met with strong resistance from the general populace.

Postulating and analyzing systems for any region requires that effort and concentration be directed at large quantity wastes and methods of alteration that result in maximum reduction in regional bad effects within practical bugetary limits. In the Fresno region study, emphasis in depth has been placed on synthesizing and analyzing systems for managing municipal refuse, industrial organic refuse, and manures from cattle feed lots, dairies and poultry farms. At present, these wastes make up approximately two thirds of the total solid wastes generated in the region and, due to their putrescibility, account for an even larger percentage of the total regional bad effects from solid wastes. While systems have been proposed for handling all wastes, it was determined that improved controls on manures, municipal refuse, and industrial organic wastes would be most productive in reduction of environmental effects and a variety of methods for handling these wastes were analyzed. No procedures for handling field crop residues were considered, other than plowing in the ground, and no additional processing of orchard trimmings was postulated, other than reduction by chippers or grinders in areas where burning should be restricted.

The procedures and methodologies evolved in the Fresno region study are applicable to other similar regions, but the system devised for a particular region other than Fresno should reflect the waste quantity mix and special waste problems peculiar to that region as well as the financial capacity, desires, and habits of the region's population.

5. System Performance

a. Performance Scoring

After a number of systems have been evolved, the bad effects score of each system is calculated using the previously determined quantities of wastes to be handled and the total bad effects score for each unit quantity of waste in the handling condition and for the durations postulated by the proposed system. Waste management procedures scored include storage, transportation, processing and disposal. Scoring the systems requires separate scores for those procedures which are considered transient, such as storage and transportation, and those which are considered final disposal. Waste processing can be considered either transient or disposal, depending on the process or the system in which the process is used. To use the procedure developed in this study, a determination as to category, either transient or disposal, must be made for each waste processing procedure and its bad effects combined with the transient or the disposal scores, whichever is appropriate to the system.

For the purpose of comparison and to determine the percent improvement of the proposed systems, the existing system of solid wastes management must also be scored in the same manner as described above. The transient and disposal component scores for the proposed system are then compared with the existing system scores to determine the percent improvement of each component. On the assumption that each of the two components, transient and disposal, is of equal importance to society, the final total system improvement is the average of the improvements of the transient and disposal components when compared to the total existing system score.

b. System Cost Estimating

The costs per ton of waste handled for each system scored, including the existing, must be determined so that the systems can be compared as to cost effectiveness. A vast amount of cost data is available from the Solid Waste Program, American Public Works Association and various state, local, and private agencies.

All waste management systems considered were separated into unit functions of storage, collection, transportation, processing, and final disposal. From available data and extrapolations (advanced concept functions were, for the most part, developed by extrapolating existing industrial process costs) all function costs were determined on a per ton handled basis. The total cost per ton of waste handled for the various systems considered was then determined by combining the unit function costs of each system.

To determine waste management system final costs in regions other than Fresno, consideration must be given to local physical and economic conditions. The costs of local labor, material, construction, and land must be considered, as well as the local topography and availability of suitable sites for proposed system processes. Comparison of systems costs can be made, however, utilizing the costs developed in this study.

c. Cost Effectiveness

With the data on percent improvement and cost per ton handled for each system considered, those systems whose costs are within the local budgetary limitations are compared and a final system is determined that will provide the greatest possible improvement of environmental effects of solid waste for the least expenditure.

d. Ancillary Effects

The performance scoring technique described in Section IV of this report is based primarily on the value judgments of individual environmental scientists and engineers, and is, consequently, empirical in nature. Minor differences in total scores (± 10 percent) cannot be considered totally definitive. In the event that several promising system evaluations result in similar performance capabilities and costs, the application of the ancillary effect scoring procedures developed in Section V of this study can be used to further refine the selection process.

The ancillary effects are defined as the environmental effects of the physical components of a waste management system, rather than effects of the wastes. Twelve ancillary effects were scored for the Fresno study, including social effects, such as employment and legal problems; physical effects, such as noise and traffic interference; as well as those environmental effects previously scored for the solid wastes, such as odors and unsightliness, where applicable to systems components. The relative importance of the ancillary effects were established for each of the subregions of the study region by the scoring of a cross section of the general public in addition to scoring by environmental health experts. For each subregion, the effect with the highest total score was rated as 1.00 in importance and the other effects were given fractional ratings in proportion to their total scores.

Application of the ancillary effect scoring procedure to waste management systems in regions other than the Fresno region could require that additional effects not scored in the Fresno study be considered for the region in question and some of the effects previously scored considered inapplicable. To arrive at a list of ancillary environmental effects in a particular region will require the canvassing of local lay population as well as local government authorities and environmental health experts. To arrive at a relative importance rating schedule for the effects decided upon, a statistical sampling of the local population should be made, including the experts, to achieve a relative importance rating schedule which is truly representative of the region in question.

C. SUMMARY & EVALUATION

The scoring procedures and methodologies developed in the Fresno region study can be applied with very little alteration directly to regions which have similar environmental parameters. Application of procedures to regions with vastly different characteristics will require attention and study of the special regional problems in waste characteristics and production, economic capacity, political organization and the social behavior, habits, prejudices and desires of the local population.

The procedures developed, while a significant step forward in waste management system evaluation, are still in need of refinement to achieve the ultimate potential of the systems analysis approach to the solution of waste management problems. Additional studies are needed to develop a more uniform and more flexible costing methodology, to refine and expand the environmental effects scoring procedure and to develop more meaningful ancillary effects data.

Finally, it should be recognized that the basic hypothesis for the growth characteristics of the Fresno Region is that the useage of land will occur with relatively little influence by government to protect agricultural lands (through "greenbelt" legislation) and that urban growth will occur without consideration of long-range programs. The value of the fertile agricultural "breadbasket" that comprises portions of the great Central Valley of California — both to the economy of the State, as well as entire Nation — may hopefully bring forth a bold, new approach to regional planning that will help to locate people on land that has less utility for agriculture, while preserving the most fertile soils for our continued use, and for use by our posterity. Such long-range programs for land use would minimize the conflict between solid wastes and the environment and could result in substantial improvements in system performance at reduced cost.

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